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YAKIMA RIVER BASIN CLASS II INSPECTIONS AT TOPPENISH, ZILLAH, SUNNYSIDE, MABTON, WAPATO, MOXEE, SELAH, ELLENSBURG, AND GRANGER WASTEWATER TREATMENT PLANTS

by
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Waterbody Nos. WA-37-1030
and WA-39-1030

April 1993

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ABSTRACT

Unannounced Class II inspections were conducted at nine municipal wastewater treatment plants in the Yakima River Basin during September 14-23, 1992. The most frequent problems, each occurring at about half the plants, were:

- potential for chlorine toxicity in the receiving water;
- potential for ammonia toxicity/nutrient enrichment in the receiving water;
- wasteload to WWTP exceeds one or more design criteria;
- potential for violation of weekly/monthly average fecal coliform counts; and
- flow measuring instrumentation needs calibration.

Several plant sites need better maintenance practices; several are understaffed. Two of the WWTPs have considerably more problems than the remaining seven, namely Zillah and Mabton. Six of the nine facilities inspected during this survey have wastewater discharge permits that are due for reissuance. The potential of receiving water toxicity and plant overloading are two issues which should be addressed in revised permits, specifically by requiring mixing zone evaluations and planning for plant upgrades.

INTRODUCTION

Unannounced Class II inspections were conducted at the following nine municipal wastewater treatment plants (WWTP) along the lower Yakima River during a two week period in September 1992: Toppenish, Zillah, Sunnyside, Mabton, Wapato, Moxee, Selah, Ellensburg, and Granger. The first five WWTPs were inspected during the week of September 14; the remaining four during the week of September 21. Ellensburg's wastewater included increased flow from Central Washington University where fall quarter had started that week.

Conducting the inspections were Norm Glenn, Tapas Das, and Rebecca Inman of the Environmental Investigations and Laboratory Services Program (EILS), Watershed Assessments Section, and Phelps Freeborn of Ecology's Central Regional Office. Plant personnel were very helpful and cooperative under the trying conditions imposed by unannounced inspections. Data gathered during this survey will eventually contribute to the Yakima River Total Maximum Daily Load (TMDL) study, scheduled to begin in the summer of 1993. Figure 1 is a map of the basin showing the locations of all nine WWTPs.

Objectives of the inspections included:

1. verify compliance with NPDES permit limits;

2. determine loadings and removal efficiencies;

3. evaluate permittee's self-monitoring by reviewing sampling and flow measuring procedures, and by conducting sample splits; and

4. provide effluent data to support the river TMDL assessment.

PROCEDURES AND DATA QUALITY ASSURANCE

Sampling and Inspection Procedures

All sampling equipment was cleaned before use by washing with non-phosphate detergent and rinsing with tap water. Collection equipment was air-dried and then wrapped in aluminum foil until used.

Parshall flumes were inspected for correct installation and critical dimensions. Instantaneous flows were determined where possible by measuring depth of flow through the device and reading resultant flows from tables (ISCO, 1985). Comparisons were then made to instantaneous readings on the plant flow recorders. This was not possible at those WWTPs which use ultrasonic or in-line propeller flow meters (Toppenish, Sunnyside, Wapato, Selah, and Ellensburg). Twenty-four-hour flows were also recorded from totalizers by taking readings at the same hour on consecutive days.

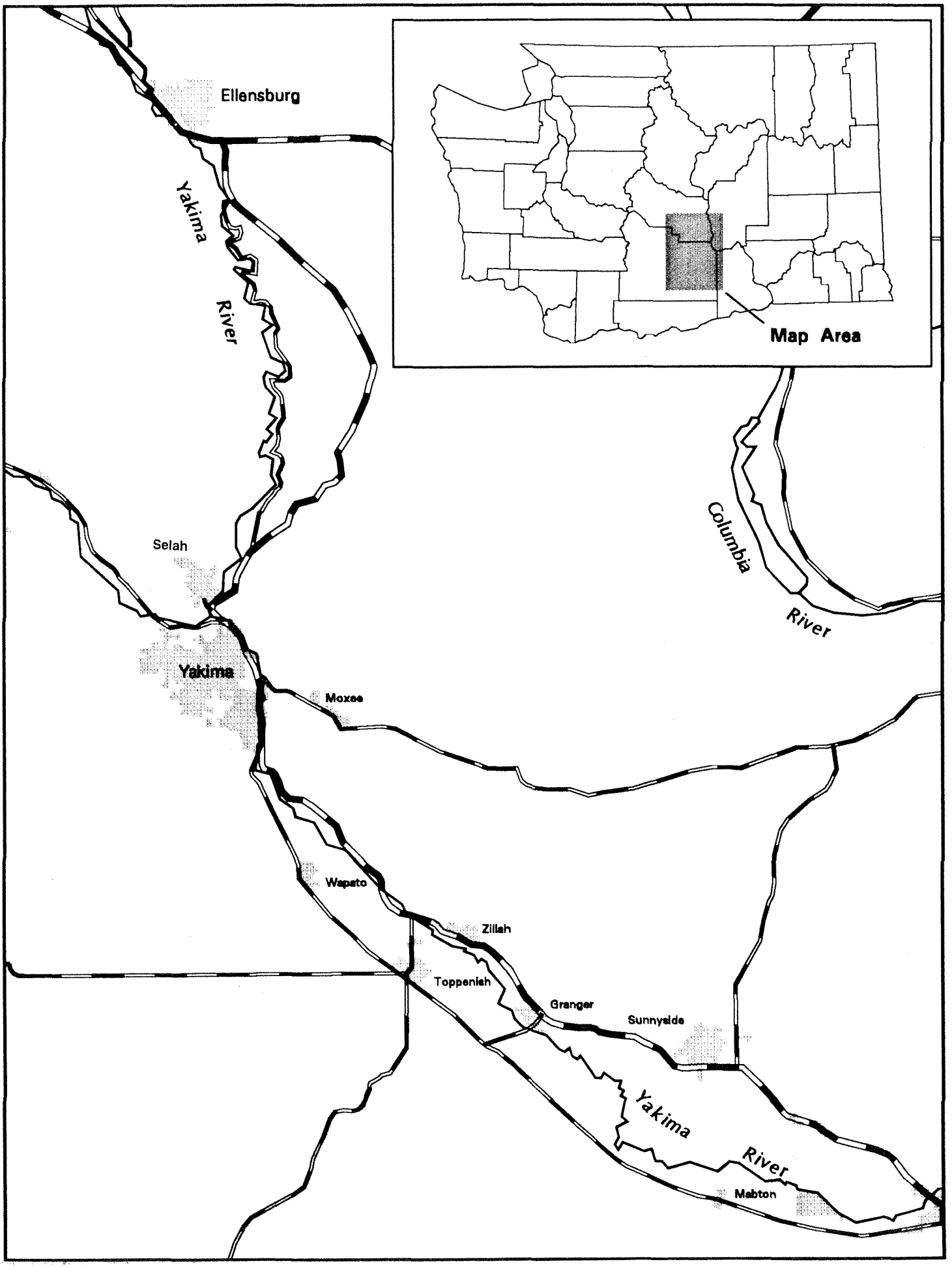

Figure 1. Location Map - WWTPs on the Lower Yakima River, 9/92

Ecology's ISCO® composite samplers were set to collect approximately 230 mL of sample every 30 minutes for 24 hours. The lone exception was the composite sample of effluent taken at Wapato. The compositor collected sample for only 11 hours due to scheduling difficulties. This has been so noted on Table 13. Compositor bottles were kept continually iced during sample collection, but composited samples were not always at the requisite 4°C when checked. High ambient temperatures, warm wastewater, the logistical problem of having to visit a number of plants in several days, and an inability to add ice during the night were contributing causes. In addition to composite samples of influent and effluent, three grab samples of effluent were collected at each of the nine plants. All samples for analysis by Ecology were placed on ice until delivery to the Ecology Manchester Laboratory.

Data Quality Assurance

Data quality and quality of the reporting were assured through careful attention to representativeness of samples collected, as well as accuracy (precision and bias), completeness, and comparability of data such that the stated objectives of the inspections were met. At the time of the inspections, permittee sampling locations appeared to be appropriate and representative, and Ecology's sampling was conducted in close proximity, with three exceptions: 1) Zillah's effluent sampling was pre-chlorination while ours was post-chlorination; 2) Sunnyside's influent sampling was from the "back" of a manhole to the side of the intermittent flow stream, while ours was from the mouth of the pipe entering the manhole; and 3) Ellensburg's influent sampling was downstream from the supernatant return line, while ours was upstream (however, they agreed to not return supernatant during our inspection). Figures 2 through 10 show Ecology's sampling locations.

Orthophosphate samples were filtered in the field using 0.45 micron filters and amber nalgene bottles. Equipment blanks were also prepared in the field at each site by exposing distilled water to the equipment used to filter the samples. The blanks were analyzed for orthophosphate only and indicated no bias due to contamination. Four samples (388457, -415, -416, and -417) from week 1 of the survey yielded orthophosphate concentrations greater than total phosphate concentrations. The Manchester Lab had no explanation (Thomson, 1993). All total phosphate data from week 2 contained a "J" qualifier, while none from week 1 was qualified. The concentrations were not remarkable, but nonetheless these four data pairs should be used with caution.

Results of 12 of 13 sample splits analyzed for BOD_5 were lower from the Ecology contract lab than from permittee labs. Some were significantly lower. The seed used is a possible explanation. Specifically, a seed obtained from the same wastewater as the sample will contain a mix of microorganisms which is better acclimatized, and therefore more effective in metabolizing wastes (which results in a higher sample BOD). Three BOD_5 results (sample numbers 388402, 388418, and 398463) were extraordinary, considered unusable, and are not reported.

One sample from each WWTP was analyzed at the Manchester Lab for its biological oxygen demand over a 35-day period (BOD_{35}). Two dilutions (2X and 4X) were set up and run side-by-side from each sample, for a total of 18 results (excluding quality control [QC] runs). All dilutions were to be monitored and re-aerated when necessary to ensure adequate oxygen concentrations. Nitrogenous (NBOD) and carbonaceous (CBOD) oxygen demands were measured separately at regular intervals (nine times) during the 35 days.

Twelve of the 18 dilutions were rendered unusable because the concentration of dissolved oxygen (D.O.) dropped below 1 mg/L (or below 2 mg/L more than once) before reaeration. The remaining six were considered accurate. These six represented four WWTPs, and the four results have been reported in the appropriate general chemistry tables for those WWTPs. NBOD and CBOD demands were added to give the four BOD_{35} results found in the tables. An explanation of the lab protocol for the BOD_{35} analysis can be found in Whittemore (1991).

Ultimate carbonaceous biochemical oxygen demand (UCBOD) values and appropriate kinetic descriptions are needed for the upcoming TMDL study of the river. A computer model (NCASI, 1987) was used to generate a statistical fit to the observed CBOD data and calculate a UCBOD and BOD reaction-rate constant, k (base e). However, UCBODs and k constants were only calculated and reported for the four usable 35-day results. Completeness of this data set is considered adequate to meet survey objectives because only several values will be needed for the various reaches of the river during TMDL modeling.

The third effluent grab sample collected at each WWTP (labeled ____-T) was a field replicate of the second, for the purpose of field and lab quality control. No concerns about accuracy of data were revealed by duplication of samples. Four Kjeldahl nitrogen results (sample numbers 398-481, -483, -486, and -487 from the same WWTP) were lower than ammonia results from the same sample. These four Kjeldahl results were extraordinary, considered unusable, and are not reported in Table 22. Recommended holding times were met for all analyses performed, except one: the nitrate/nitrite from sample number 388453.

Effluent composite samples were split two ways for comparative analyses, *i.e.*, <u>both</u> Ecology's and the permittee's samples were analyzed at <u>both</u> laboratories. Under proper circumstances, these two splits can produce revealing information about both sample representativeness and laboratory analytical techniques. Results from samples collected by two different compositors (Ecology and the permittee) but analyzed at the same lab (*e.g.*, Ecology) address the issue of sample representativeness. Results from samples collected by the same compositor (*e.g.*, Ecology) but analyzed at two different labs (Ecology and the permittee) address the issue of lab performance. In addition to the splits, performance evaluation (PE) standards for BOD and residual chlorine were left for analysis with each permittee whose laboratory had not yet been accredited by Ecology.

Results of sample splits focused some concern on accuracy of TSS data. Lab performance appeared to be the issue more than sample representativeness. Comparisons between Ecology lab and permittee lab results were more than 23 percent apart in 11 of 15 cases, but no consistent pattern emerged.

Laboratory quality assurance and quality control (QA/QC) methods are described by Huntamer and Hyre (1991) and Kirchmer (1988). A summary of analytical methods and laboratories conducting the analyses of Ecology samples is given in Appendix A. Appendix B shows a typical suite of general chemistry parameters analyzed for during basin Class II inspections.

RESULTS AND DISCUSSION

Analytical results for each of the nine dischargers are included in three tables - a total of 27 tables. Discussion for each permittee progresses through four subjects, consistent with the objectives of the inspection. These objectives were:

- flow measurement
- general chemistry results
- comparison to NPDES permit limits
- comparison of sample splits/standards results

Flow measurement could not be independently verified if there was only an electronic or propeller, in-line flow meter (but no flume or weir).

The ensuing discussion may, from time to time, refer to concentrations of ammonia and/or chlorine in effluent which exceeded either or both acute and chronic water quality criteria. This is a literal interpretation of data in the absence of mitigating information about the dilution capacity of the receiving water. Temperature and pH of the effluent were used when determining the criteria because field data for these parameters was not collected for the various receiving waters. Criteria were selected from the table headed, "Salmonids or other sensitive cold water species present" (EPA, 1986). A mixing zone study may be necessary to generate this information.

When comparing results to permit limits, the terms "exceeded" and "higher than" may appear in the discussion. It is important to understand that the inspections covered a 2-3 day period of time while many limits are based on averages of data collected over longer periods of time. So, with the possible exception of pH, enforceable violations are not occurring, and the intent is to focus attention on patterns which may lead to violations.

Toppenish

The Toppenish WWTP uses primary and secondary clarification around three parallel trains of two rotating biological contactor (RBC) units each (Figure 2). There are two chlorine contact chambers in parallel and two anaerobic digesters in series. Effluent is discharged to the East

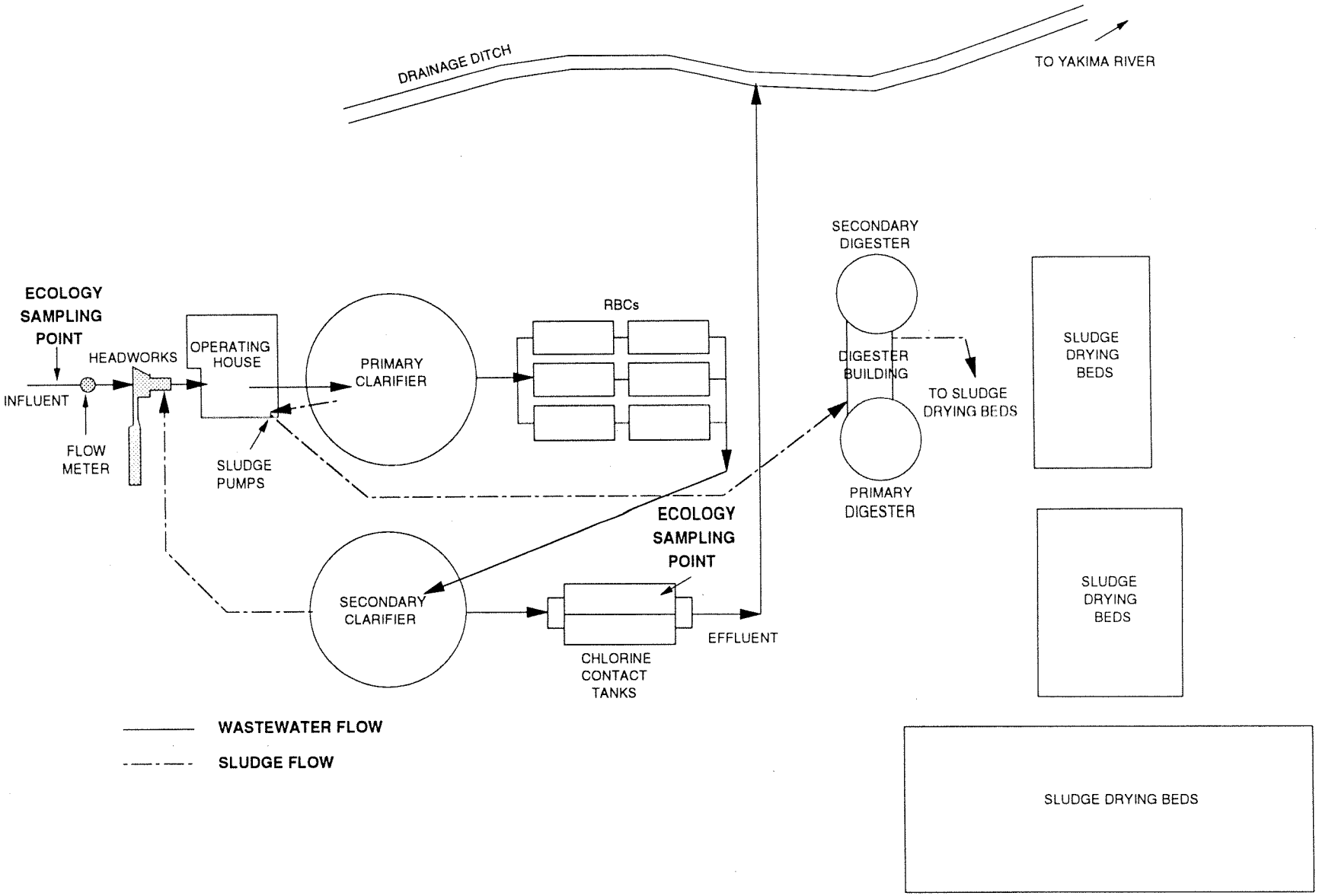

Figure 2. Plant Schematic - City of Toppenish WWTP.

Toppenish Drain of the Wapato Irrigation Project, which carries irrigation water back to the Yakima River. NPDES permit no. WA-002068-1 was issued on July 1, 1982; it has been administratively extended since expiring in 1987.

Only the influent flow is measured at this plant, using an in-line ultrasonic flow meter (Sparling 500®). It was not possible to independently verify accuracy of the flow meter. Totalizer readings placed the flow at 1.54 million gallons/day (MGD). The average of 24 data points (each hour) from the chart recorder was 1.66 MGD, which was quite close to the totalizer reading considering noise in the recording.

General chemistry results in Table 1 reflect a weak domestic wastewater (Metcalf & Eddy, 1991). This may be attributable to infiltration in the sewer lines due to irrigation-induced shallow groundwater. Little nitrification was taking place, but ammonia concentrations entering the plant were weak. The UCBOD was 28.9 mg/L and k was 0.0819.

The WWTP was operating well despite indications that it is overloaded, at least during summer months. Table 2 shows that quality of effluent was excellent and nearly 85 percent removal was being achieved in spite of weak influent. Hydraulic and solids loading did exceed design criteria. The permit specifies that when the facility reaches 85% of any of the design criteria, planning for an upgrade must begin. Obviously, loading is well beyond this threshold. The site appeared to be very well maintained.

Comparison of the results of sample splits is shown in Table 3. TSS results did not compare as well as expected; Toppenish laboratory analyses generally produced higher concentrations - by about 25 percent. The result from a TSS standard left for them to analyze could have shed some additional light on whether the disparity is due to Ecology or Toppenish - sampling, lab procedures, or both. This TSS disparity is important at Toppenish because, as Table 2 shows, the 85% removal requirement is not met using the Ecology results.

Results from analyses of other standards left with Toppenish were acceptable:

Parameter	TP Result	True Value	Acceptable Range
BOD_5	30.0 mg/L	18.6 mg/L	13.1 - 30.9 mg/L
Residual Cl_2	1.50 mg/L	1.40 mg/L	0.91 - 1.72 mg/L

Zillah

The Zillah WWTP consists of an oxidation ditch, secondary clarifier, Parshall flume, and chlorine contact chamber (Figure 3). Effluent is chlorinated immediately ahead of the flume, pumped under Highway I-82, and discharged into the Yakima River. There is no sludge digester; waste sludge is pumped to drying beds and/or hauled away. NPDES permit no. WA-002016-8 was issued on July 2, 1982 and has been administratively extended since its expiration in 1987.

Table 1. General Chemistry Results, City of Toppenish - Yakima River Basin Class II Inspections, 9/92.

Location:	Blank	Inf-E	Inf-TP	Eff-E	Eff-TP	Eff-1	Eff-2	Eff-T
Type:	Equip	Comp	Comp	Comp	Comp	Grab	Grab	Grab
Date:	9/15	9/14-15	9/14-15	9/14-15	9/14-15	9/15	9/15	9/15
Time:	1930	24 hour	24 hour	24 hour	24 hour	1045	1615	1625
Lab Log #:	388400	388401	388402	388403	388404	388405	388406	388407
GENERAL CHEMISTRY								
Alkalinity (mg/L)		149		137	137	122	123	122
Conductivity (μmho/cm)		422		423				
Chloride (mg/L)					29.5			
TS (mg/L)		420	384	299	300	381	346	290
TNVS (mg/L)		201	186	180	175	118	160	183
TSS (mg/L)		133	117	21	20	13	18	16
TNVSS (mg/L)		33	23	7	5	3	4	3
BOD5 (mg/L)		87	**	12	13	7	7	9
BOD35 (mg/L)				70				
NH3-N (mg/L)		8.48		6.53		4.88	6.91	7.14
NO2+NO3-N (mg/L)		1.19		2.74		2.86	3.35	3.36
T-Phosphate (mg/L)		3.03		2.13		1.57	1.58	1.62
O-Phosphate, dissolved (mg/L)	0.04			1.65		1.47	1.22	1.35
Kjeldahl Nitrogen (mg/L)		12.6		13.7		6.1	11.2	9.8
F-Coliform MF (#/100mL)						8 U	8 U	8 U
Total Coliform (#/100mL)						93 J		
FIELD OBSERVATIONS								
Flow (MGD)				1.54				
Temperature (°C)		5.1*		1.4*		11.5	19.4	
pH (s.u.)		7.9		7.7		7.4	7.4	
Conductivity (μmho/cm)		350		400		380	400	
Chlorine, Free (mg/L)						0.1	0.3	
Total (mg/L)						0.8	1.0	

Inf - Influent; Eff - Effluent; E - Ecology sampler; TP - Toppenish sampler; T - duplicate

* - Iced composite.

** - Refer to Procedures and Data Quality Assurance section in text.

U - Not detected at or above the reported result.

J - Positively identified but result is estimated.

Table 2. Comparison of Inspection Results to NPDES Permit Limits, City of Toppenish - Yakima River Basin Class II Inspections, 9/92

	NPDES Permit Limits		Inspection Data		Loading and Performance			
Parameter	Monthly Average	Weekly Average	Ecology Composite	Grab Samples	Design Criteria (DC)	Derived Results	Plant Loading (% of DC)	Planning to begin (% of DC)
Influent BOD5								
(mg/L)			87					
(lbs/d)					1,500	1,120	75	85
Effluent BOD5								
(mg/L)	30	45	12	7;7;9				
(lbs/d)	338	507				150		
(% removal)	85					86		
Influent TSS								
(mg/L)			133					
(lbs/d)					1,700	1,710	101	85
Effluent TSS								
(mg/L)	30	45	21	13;18;16				
(lbs/d)	338	507				270		
(% removal)	85					84		
Fecal Coliform								
(#/100 mL)	200	400		8 U;8 U;8 U				
pH (s.u.)	6.0≤pH≤9.0			7.4;7.4				
Flow (MGD)	1.35				1.35*	1.54	114	85

U - Not detected at or above the reported results.

* - Summer Average Flow

Table 3. Comparison of Laboratory Results of Sample Splits, City of Toppenish - Yakima River Basin Class II Inspections, 9/92

Location:	Inf-E		Inf-TP		Eff-E		Eff-TP	
Lab Log #:	388401		388402		388403		388404	
Date:	9/14-15		9/14-15		9/14-15		9/14-15	
Sampler:	Ecology		Toppenish		Ecology		Toppenish	
Laboratory:	Ecology	Toppenish	Ecology	Toppenish	Ecology	Toppenish	Ecology	Toppenish
BOD5 (mg/L)	87	93	*	95	12	14	13	13
TSS (mg/L)	133	138	117	167	21	24	20	30

U - Not detected at or above the reported results.

* - Refer to Procedures and Data Quality Assurance section in text.

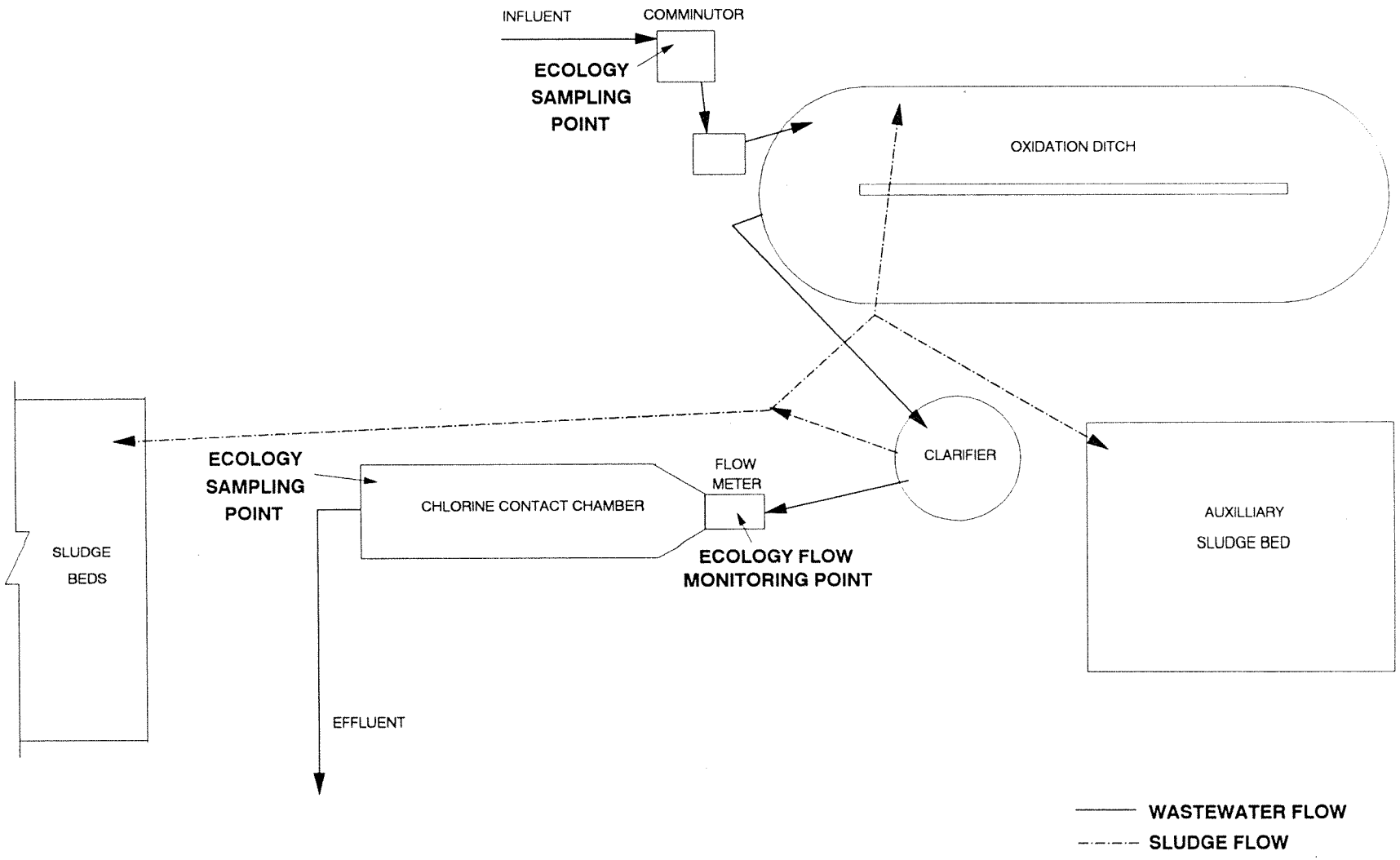

Figure 3. Plant Schematic - City of Zillah WWTP.

The flow measuring device, a 3-inch Parshall flume, is located immediately upstream of the chlorine contact chamber. The flume appeared to be correctly installed and dimensioned, and the mechanical ball float properly positioned. A comparison was made between measured flow through the flume and recorded flow at the same instant on the flow recorder. The measured flow was 18% lower (172 gal./min. versus 210). Recalibration of the flow measuring/recording system is advisable. Readings from the totalizer on consecutive days gave 0.26 MGD.

Many of the results shown in Table 4 confirm the presence of an extraordinary source of wastewater. Alkalinity, conductivity, total solids, TSS, and BOD_5 were present in very high concentrations. Influent had an obvious yellow color in the early morning (0800 - 0930). This was visible on the first day and confirmed by the operator. For this reason, an additional grab sample was taken on the morning of the second day (InfZn-1). The yellow color was again present, and a pH of nearly 10 was read.

The relatively high pH (8.0) may be forcing the distribution of free chlorine from hypochlorous acid to hypochlorite. Hypochlorous acid has about 40 to 80 times greater killing efficiency than hypochlorite for the same contact time. Great care must be taken to ensure that the proper contact time is maintained. Initial mixing of the chlorine and wastewater, and configuration of the contact chamber are important. The chlorine contact chamber at Zillah is a single basin with a short serpentine flow path, *i.e.*, the baffles are perpendicular to the length rather than the more common parallel design. Less dead zones with respect to flow (and therefore, increased hydraulic detention time) and better mixing may be achievable with a better design. Chlorination is delivered flow proportional.

The biological process appeared to be performing well in spite of the extraordinary influent source; TSS and BOD_5 were reduced significantly beyond the 85 percent removal requirement. However, the effect of this discharge on the receiving water warrants further examination due to the proximate location of the outfall to shore. Chlorine toxicity in the receiving water is potentially a major concern, especially considering that discharge is two feet from shore into one foot of water, and that acute and chronic water quality criteria for total chlorine residual are 0.019 and 0.011 mg/L, respectively. Effluent total ammonia concentrations (8.8 mg-N/L) were also sufficiently high to raise concerns about toxicity. Acute and chronic water quality criteria were about 8.2 and 1.2 mg-N/L, respectively.

The treatment process does not include sludge digestion, and the operator spends an inordinate amount of time hauling sludge away to city-owned property. A sludge digester may prove to be cost-effective. A second operator/lab technician is an urgent need at this WWTP. The BOD_{35}, UCBOD and k constant results were not considered accurate and aren't included.

Table 5 shows that permit limits were being met with the exception that BOD_5 loading far exceeded and hydraulic loading slightly exceeded design criteria. Assuming that the TSS result from Ecology's composite sample is representative, then TSS loading to the plant (2,600 lb/day) is extraordinarily high. The operator confirmed that the oxidation ditch is overloaded and sometimes goes anaerobic.

Table 4. General Chemistry Results, City of Zillah - Yakima River Basin Class II Inspections, 9/92.

Location:	Blank	Inf-E	Inf-Z	Inf-1	Eff-E^	Eff-Z^	Eff-1	Eff-2	Eff-T
Type:	Equip	Comp	Comp	Grab	Comp	Gr-comp	Grab	Grab	Grab
Date:	9/15	9/15-16	9/15-16	9/15	9/15-16	9/15-16	9/15	9/15	9/15
Time:	1930	24 hour	24 hour	0855	24 hour	8 hour	0930	1440	1450
Lab Log #:	388410	388411	388412	388418	388413	388414	388415	388416	388417
GENERAL CHEMISTRY									
Alkalinity (mg/L)		419			340		342	337	337
Conductivity (μmho/cm)		1730			1260				
Chloride (mg/L)			87.8	72.0	142				
TS (mg/L)		2880	1360	1110	892		1020	873	899
TNVS (mg/L)		1190	672	505	686		664	712	649
TSS (mg/L)		1480	230	328	22		8	14	16
TNVSS (mg/L)		358	93	110	9		1	1	3
BOD5 (mg/L)		495	405	*	14	10	3 U	3 U	3 U
TOC (mg/L)					101				
NH3-N (mg/L)		16.7			7.28		9.13	9.41	9.44
NO2+NO3-N (mg/L)		2.84			0.47		0.60	0.69	0.68
T-Phosphate (mg/L)		11.7			2.05		4.32	3.87	3.78
O-Phosphate, dissolved (mg/L)	0.01 U				3.56		4.92	5.21	5.00
Kjeldahl Nitrogen (mg/L)		48.6			18.1		11.8	11.1	13.7
F-Coliform MF (#/100mL)							8 U	46 BOF J	31 BOF J
FIELD OBSERVATIONS									
Flow (MGD)					0.21				
Temperature (°C)		5.0**	6.2**	18.7	5.1**		18.7	19.2	
pH (s.u.)		8.3	8.6	9.7	8.0		8.0	7.8	
Conductivity (μmho/cm)		1410	1130	990	960		1110	1080	
Chlorine, Free (mg/L)							0.5	1.5	
Total (mg/L)							6.0	6.0	

Inf - Influent; Eff - Effluent; E - Ecology sampler; Z - Zillah sampler; T - Duplicate
^ - Eff-Z sampling location was prechlorination; eff-E was post-chlorination.
BOF - Bottle overfull; could not shake.
U - Not detected at or above the reported result.
J - Positively identified , but result is estimated.
* - Refer to Procedures and Data Quality Assurance section in text.
** - Iced composite.

Table 5. Comparison of Inspection Results to NPDES Permit Limits, City of Zillah – Yakima River Basin Class II Inspections, 9/92

	NPDES Permit Limits		Inspection Data		Loading and Performance			
Parameter	Monthly Average	Weekly Average	Ecology Composite	Grab Samples	Design Criteria (DC)	Derived Results	Plant Loading (% of DC)	Planning to begin (% of DC)
Influent BOD5								
(mg/L)			495					
(lbs/d)					425	1,070	252	85
Effluent BOD5								
(mg/L)	30	45	14	3 U;3 U;3 U				
(lbs/d)	50	75				30		
(% removal)	85					97		
Influent TSS								
(mg/L)			1,480	328				
(lbs/d)						3,200		
Effluent TSS								
(mg/L)	30	45	22	8;14;16				
(lbs/d)	50	75				48		
(% removal)	85					99		
Fecal Coliform								
(#/100 mL)	200	400		8 U;46 BOF J;31 BOF J				
pH (s.u.)	6.0≤pH≤9.0			8.0;7.8				
Flow (MGD)	0.2				0.2	0.26	130	85

U – Not detected at or above the reported results.

Results from the sample split (Table 6) and standards exercise were of limited value. Zillah's influent samples were collected as 24-hour automatic composites; effluent samples as 8-hour grab-composites. The unusually high TSS result from the Ecology lab (1480) of Ecology's influent sample could have been due to the use of a weighted strainer on the end of the sampling line and the necessity to place it on the bottom of the channel. However, this does not explain why the TSS concentration produced by the Zillah lab (335) of Ecology's influent sample was less than one-fourth as much as Ecology's result from the same compositor. There is no obvious reason to consider the Ecology result an outlier.

The splits of Ecology's composite samples given to Zillah to be analyzed for BOD_5 were seeded incorrectly (Tilley, 1992b). Neither the first nor the second set of results from the BOD_5 standards were returned to this office. Results from analyses of standards are as follows:

Parameter	ZL Result	True Value	Acceptable Range
BOD_5	not received	18.6 mg/L	13.1 - 30.9 mg/L
Residual Cl_2	1.40 mg/L	1.40 mg/L	0.91 - 1.72 mg/L

Sunnyside

The Sunnyside WWTP combines trickling filter treatment with activated sludge treatment (Figure 4). The headworks includes an aerated grit chamber. Primary clarification is assisted by using alum as a settling aid. The two trickling filters are operated in parallel without recirculation, followed by the solids contact basin with diffused air and then secondary clarifiers. Primary and secondary sludge is treated in two digesters, one aerobic, and one anaerobic plus drying beds. Discharge is to Drainage Improvement District (DID) ditch #3, a tributary to Sulphur Creek, which is a tributary to the Yakima River. Discharge is regulated under NPDES Permit No. WA-002099-1 which was issued on June 28, 1990. This is a "major" NPDES permittee.

The in-line flow meter is located in a deep manhole just upstream of the chlorine contact chambers, which are also underground. Instantaneous flow measurements were not taken because the flow meter was inaccessible. The 24-hour totalizer gave a reading of 1.00 MGD.

General chemistry data in Table 7 indicate that conventional pollutants (such as TSS and BOD) were being reduced quite well, except for fecal coliform. Ammonia is a cause for concern. Some nitrification was taking place, but effluent ammonia concentrations (13.4 mg-N/L) were sufficiently high to raise concerns about toxicity in the receiving water. Acute and chronic water quality criteria were about 7 and 1 mg-N/L, respectively. It is not known how much dilution capability exists in DID #3, or whether a designated mixing zone would prevent violations of water quality standards.

Table 6. Comparison of Laboratory Results of Sample Splits, City of Zillah – Yakima River Basin Class II Inspections, 9/92

Location:	Inf-E		Inf-Z		Eff-E		Eff-Z	
Lab Log #:	388411		388412		388413		388414	
Date:	9/15-16		9/15-16		9/15-16		9/15-16	
Sampler:	Ecology		Zillah		Ecology		Zillah	
Laboratory:	Ecology	Zillah	Ecology	Zillah	Ecology	Zillah	Ecology	Zillah
BOD5 (mg/L)	495	---	405	261	14	---	10	29
TSS (mg/L)	1480	335	230	272	22	25	---	23

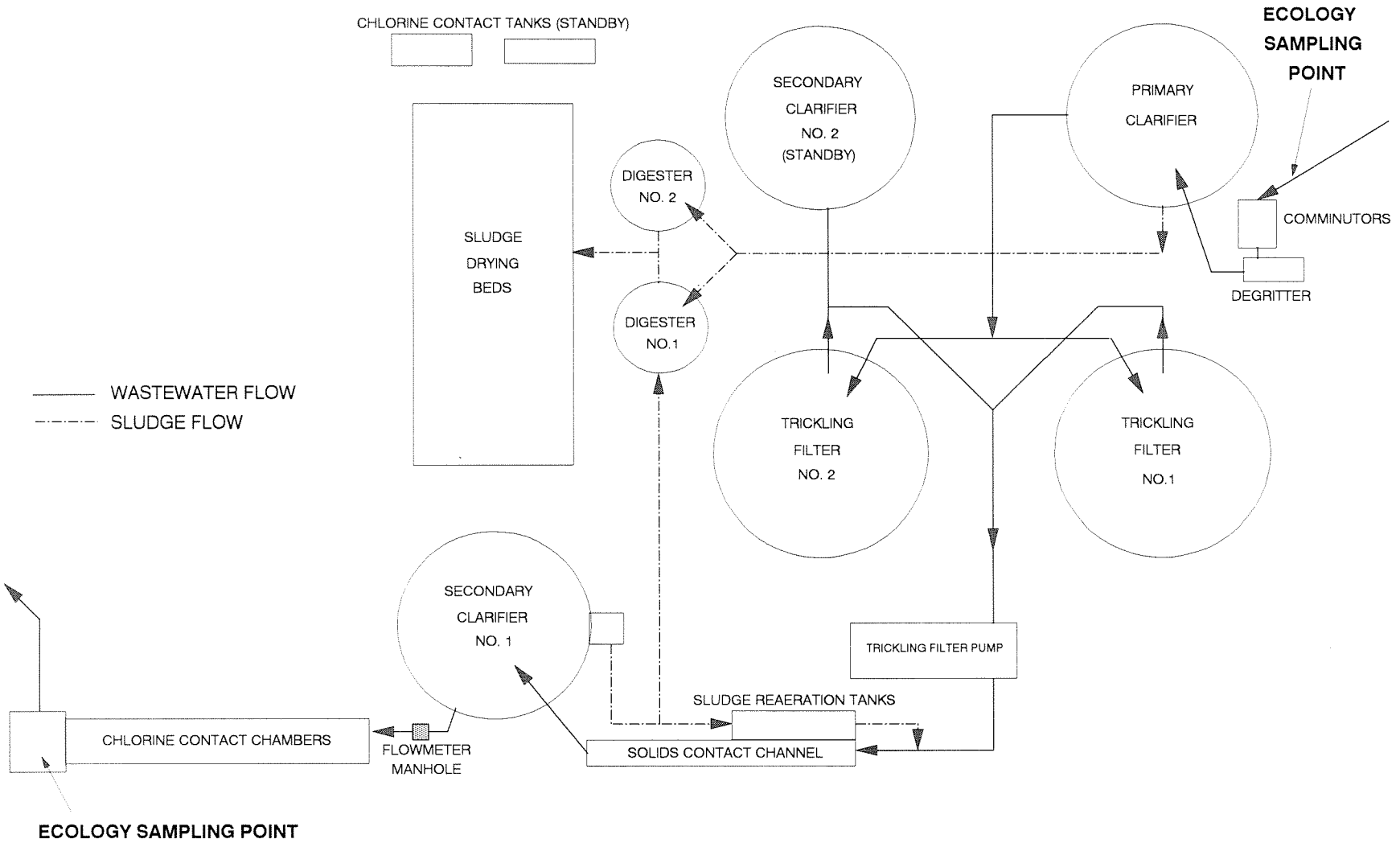

Figure 4. Plant Schematic - City of Sunnyside WWTP.

Table 7. General Chemistry Results, City of Sunnyside - Yakima River Basin Class II Inspections, 9/92.

Location:	Blank	Inf-E^	Inf-S^	Eff-E	Eff-S	Eff-1	Eff-2	Eff-T
Type:	Equip	Comp	Comp	Comp	Comp	Grab	Grab	Grab
Date:	9/15	9/15-16	9/15-16	9/15-16	9/15-16	9/15	9/16	9/15
Time:	1930	24 hour	24 hour	24 hour	24 hour	1240	0955	1250
Lab Log #:	388430	388431	388432	388433	388434	388435	388436	388437
GENERAL CHEMISTRY								
Alkalinity (mg/L)		276		191		191	192	190
Conductivity (μmho/cm)		952		895				
Chloride (mg/L)				111	106			
TS (mg/L)		911	742	654	578	619	588	581
TNVS (mg/L)		563	452	470	442	413	458	439
TSS (mg/L)		229	140	13	9	15	12	8
TNVSS (mg/L)		129	67	9	7	9	8	5
BOD5 (mg/L)		198	170	10	12	8	4	7
TOC (mg/L)				162				
NH3-N (mg/L)		22.5		13.4		12.3	13.1	11.9
NO2+NO3-N (mg/L)		0.10		2.59		2.68	2.79	2.72
T-Phosphate (mg/L)		4.34		1.06		0.82	0.81	0.84
O-Phosphate, dissolved (mg/L)	0.07			0.46		0.50	0.35	0.49
Kjeldahl Nitrogen (mg/L)		33.5		16.9		15.1	28.4	15.4
F-Coliform MF (#/100mL)						670 X	200	970 X
FIELD OBSERVATIONS								
Flow (MGD)				1.00				
Temperature (°C)		6.3*	16.8*	6.6*	11.0*	19.6	19.8	
pH (s.u.)		8.1	8.0	8.1	8.0	8.0	7.8	
Conductivity (μmho/cm)		850	920	850	750	860	900	
Chlorine, Free (mg/L)						0.1	0.15	
Total (mg/L)						0.1	0.30	

Inf - Influent; Eff - Effluent; E - Ecology sampler; S - Sunnyside sampler; T - duplicate.

^ - Inf-S sampling location was at back of manhole receiving intermittent flow; inf-E was from mouth of pipe entering manhole.

X - High background count of non-fecal, thermal-tolerant microorganisms.

* - Iced composite.

Chloride concentrations in effluent were somewhat high. Amounts present in the domestic water supply, contributed by agricultural wastewater or food processors, or created during chlorination could account for this. It is possible that this particular receiving water could also have high background concentrations (agriculture wastewater). BOD_{35}, UCBOD and k constant results were not considered accurate and are not included.

Table 8 is a comparison of results to permit limits. Only fecal coliform was noteworthy: the geometric mean of grab sample results from these two days was 506. If the same rate of bacterial kill continued, violations of both weekly and monthly average limitations would have occurred.

Table 9 is a comparison of split sample results. The influent samples produced poor comparisons, but there is no consistent pattern which might focus the problem on either sampling procedures or lab techniques. Certainly, it is difficult to get representative influent samples from a location which receives only intermittent flow. Also, Ecology's choice of a different location in the manhole from the one routinely used by Sunnyside should be assessed further. The plant's composited samples were not maintained at 4°C. as required. Sunnyside's lab has been accredited by Ecology, so no standards were left for analysis.

Mabton

Influent to the Mabton WWTP passes through a Parshall flume to an oxidation ditch and then a final clarifier (Figure 5). Discharge is directly to the Yakima River. Waste sludge is pumped to an aerobic digester and drying beds. Discharge from the WWTP is regulated under NPDES Permit No. WA-002064-8 which was issued on July 2, 1982. It has been administratively extended since expiration in 1987.

A 3-inch Parshall flume is part of the headworks at the Mabton WWTP. Water level is measured with a mechanically operated float; flows are recorded on a 7-day circular recorder and totalizer. Physical measurements and installation of the flume appeared to be correct. However, our instantaneous reading using the handbook was 0.233 MGD versus the plant's flow meter reading of 0.288 MGD. This discrepancy (24%) is excessive; the instrumentation should be calibrated. There were deposits on both sides of the flume which could affect its accuracy. Cleaning and recalibration are necessary. The totalizer gave a reading over 24 hours of 0.125 MGD.

At the time of our visit, the City was flushing sewer lines which didn't appreciably affect flow but may have affected wasteload. Large globules of grease were visible at the plant, and the general chemistry results shown in Table 10 may be atypical. Final effluent was quite turbid, and TSS and BOD_5 concentrations were excessive. Even though floating aerators have been installed in the ditch, aeration may still be insufficient. City staff acknowledged that they are having problems at the plant and are working on getting an engineering study done (Beeman, 1992).

Table 8. Comparison of Inspection Results to NPDES Permit Limits, City of Sunnyside – Yakima River Basin Class II Inspections, 9/92

	NPDES Permit Limits		Inspection Data		Loading and Performance			
Parameter	Monthly Average	Weekly Average	Ecology Composite	Grab Samples	Design Criteria (DC)	Derived Results	Plant Loading (% of DC)	Planning to begin (% of DC)
Influent BOD5								
(mg/L)			198					
(lbs/d)					6,000	1,700	28	85
Effluent BOD5								
(mg/L)	30	45	10	8;4;7				
(lbs/d)	540	811				83		
(% removal)	85					95		
Influent TSS								
(mg/L)			229					
(lbs/d)					6,000	1,900	32	85
Effluent TSS								
(mg/L)	30	45	13	15;12;8				
(lbs/d)	540	811				108		
(% removal)	85					94		
Fecal Coliform								
(#/100 mL)	200	400		670 X;200;970 X				
pH (s.u.)	6.0≤pH≤9.0			8.0;7.8				
Flow (MGD)	3.0	8.1			3.0	1.00	33	85

X – High background count of non-fecal, thermal-tolerant microorganisms.

Table 9. Comparison of Laboratory Results of Sample Splits, City of Sunnyside – Yakima River Basin Class II Inspections, 9/92

Location:	Inf-E		Inf-S		Eff-E		Eff-S	
Lab Log #:	388431		388432		388433		388434	
Date:	9/15-16		9/15-16		9/15-16		9/15-16	
Sampler:	Ecology		Sunnyside		Ecology		Sunnyside	
Laboratory:	Ecology	Sunnyside	Ecology	Sunnyside	Ecology	Sunnyside	Ecology	Sunnyside
BOD5 (mg/L)	198	246	170	289	10	12	12	10
TSS (mg/L)	229	167	140	279	13	9	9	9

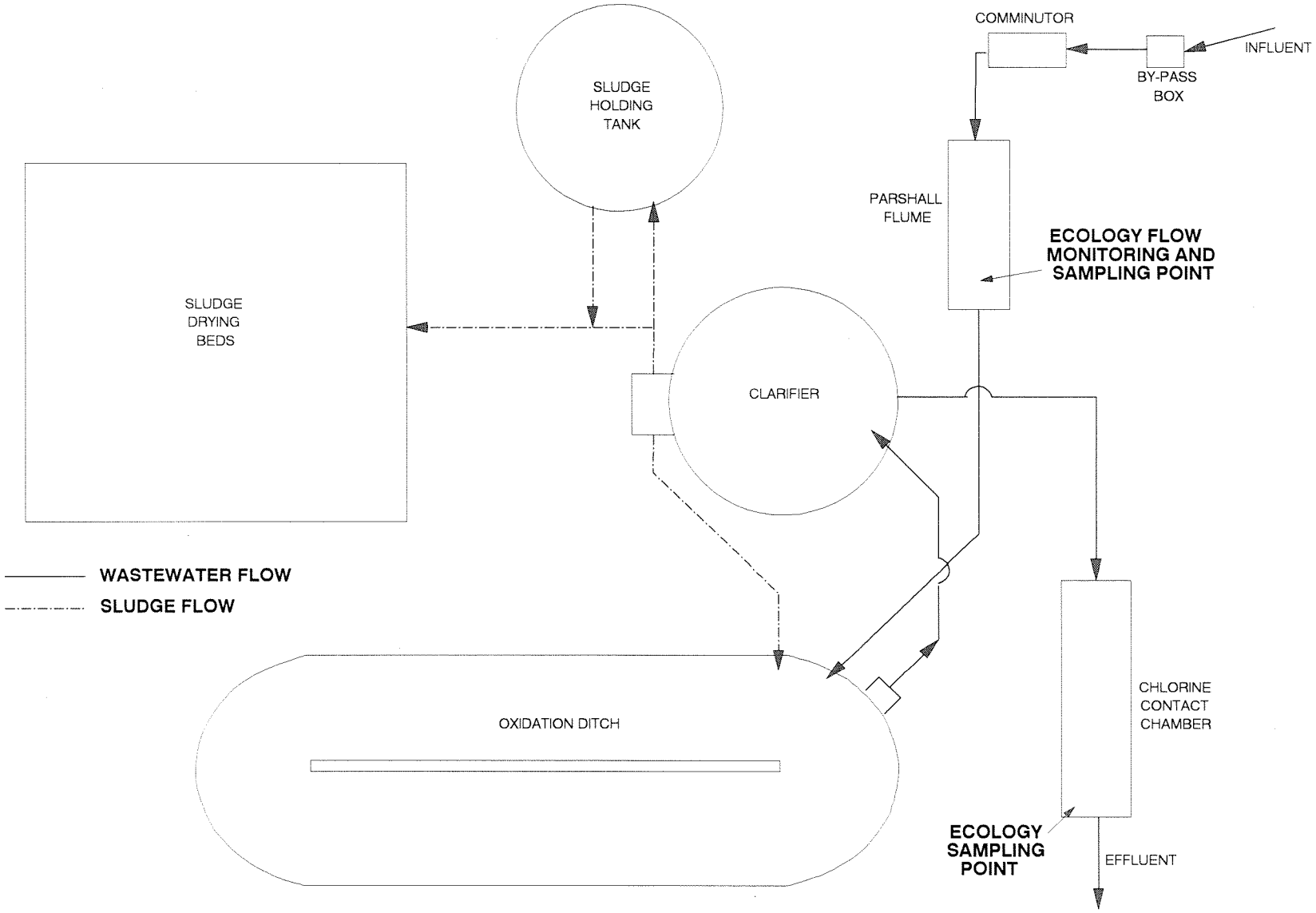

Figure 5. Plant Schematic - City of Mabton WWTP.

Table 10. General Chemistry Results, City of Mabton - Yakima River Basin Class II Inspections, 9/92.

Location:	Blank	Inf-E	Inf-M	Eff-E	Eff-M	Eff-1	Eff-2	Eff-T
Type:	Equip	Comp	Comp	Comp	Comp	Grab	Grab	Grab
Date:	9/15	9/15-16	9/15-16	9/15-16	9/15-16	9/15	9/15	9/15
Time:	1930	24 hour	24 hour	24 hour	24 hour	1135	1715	1145
Lab Log #:	388440	388441	388442	388443	388444	388445	388446	388447
GENERAL CHEMISTRY								
Alkalinity (mg/L)		264		274		273	270	274
Conductivity (μmho/cm)		721		765				
Chloride (mg/L)				66.9	70.7			
Chlorophyll a (mg/L)				3,700	1,900			
Pheophytin a (mg/L)				2,100	1,900			
TS (mg/L)		769	734	593	587	675	606	655
TNVS (mg/L)		412	407	387	388	366	355	358
TSS (mg/L)		338	242	116	78	121	84	106
TNVSS (mg/L)		123	111	11	22	39	26	44
BOD5 (mg/L)		108	86	38	31	62	51	52
TOC (mg/L)				102				
NH3-N (mg/L)		23.2		22.7		22.3	22.6	22.8
NO2+NO3-N (mg/L)		0.07		0.05		0.05	0.03	0.03
T-Phosphate (mg/L)		4.56		5.17		5.08	5.00	4.98
O-Phosphate, dissolved (mg/L)	0.02			2.84		2.87	2.86	2.37
Kjeldahl Nitrogen (mg/L)		36.5		21.4		34.0	34.7	29.7
F-Coliform MF (#/100mL)						80,000	110,000	51,000 BOF
FIELD OBSERVATIONS								
Flow (MGD)				0.13				
Temperature (°C)		7.1*	8.9*	6.7*	8.5*	20.5	21.5	
pH (s.u.)		8.0	7.9	7.8	7.4	7.6	7.6	
Conductivity (μmho/cm)		670	750	750	770	750	800	
Chlorine, Free (mg/L)						0.9	0.2	
Total (mg/L)						1.0	0.2	

Inf - Influent; Eff - Effluent; E - Ecology sampler; M - Mabton sampler; T - Duplicate.

BOF - Bottle overfull; could not shake.

* - Iced composite samples.

Ammonia, fecal coliform, and chlorine residual in the effluent were also excessive. No nitrification was taking place. The effluent ammonia concentration of 23 mg-N/L exceeded acute and chronic water quality criteria of about 13 and 1.4 mg-N/L, respectively. It is not known whether there would be sufficient dilution in a mixing zone to prevent water quality standards violations. Every attempt should be made to operate this oxidation ditch in the extended aeration mode in order to encourage nitrification.

Despite a more than adequate residual chlorine (both free and combined available), it is apparent from the fecal coliform counts that disinfection was ineffective. The two most likely explanations are: 1) inadequate initial mixing, and 2) inadequate contact time (the contact chamber was baffled with corrugated, fiberglass roofing panels to produce a serpentine path). BOD_{35}, UCBOD, and k constant values were not considered accurate and are not included.

There were a number of results which were higher than permit limits, as shown in Table 11. BOD_5 exceeded the required monthly average for both concentration and removal efficiency; TSS exceeded both the monthly and weekly averages by a wide margin and only 66 percent of solids were removed in the treatment process; fecal counts were extraordinarily high; and TSS loading in the influent exceeded the design criterion. The plant site appeared to be poorly maintained.

Results of analyses by Mabton of samples split from the Ecology compositor were not received in this office (Table 12). The "BOD's did not turn out" (Beeman, 1992); no explanation was given for the absence of TSS results. Standards were left with the plant operators (on two different occasions) but, again, results were never received. Both BOD_5 and TSS results from the Mabton 8-hour, grab-composite samples of both influent and effluent were lower than the Ecology results. This is predictable; it's doubtful that their samples are as representative (or the results as reliable) as Ecology's 24-hour composites. More representative data becomes an important factor as the time approaches for an engineering study of the WWTP.

Wapato

The Wapato WWTP uses primary and secondary clarification around two parallel trains of two RBC units each (Figure 6). There is a pair of chlorine contact chambers with mixers at the head-end of the chambers. Effluent is discharged to Wanity Slough (Drainway #2) for transport to the Yakima River. Sludge is treated in primary and secondary aerobic digesters plus drying beds. NPDES Permit No. WA-005022-9 was issued on October 18, 1982 and has been administratively extended since expiration in 1987.

There is an electronic, in-line flow meter at the influent. No physical measurements or calculation of instantaneous flows were done. Twenty-four hour flow from the totalizer was 0.85 MGD. [Note: The impact of irrigation-driven infiltration is significant. Irrigation quit around Wapato on October 2, and influent flows dropped steadily during the following week (Freeborn, 1992)].

Table 11. Comparison of Inspection Results to NPDES Permit Limits, City of Mabton - Yakima River Basin Class II Inspections, 9/92

	NPDES Permit Limits		Inspection Data		Loading and Performance			
Parameter	Monthly Average	Weekly Average	Ecology Composite	Grab Samples	Design Criteria (DC)	Derived Results	Plant Loading (% of DC)	Planning to begin (% of DC)
Influent BOD5								
(mg/L)			108					
(lbs/d)					333	110	32	85
Effluent BOD5								
(mg/L)	30	45	38	62;51;52				
(lbs/d)	48	71				40		
(% removal)	85					65		
Influent TSS								
(mg/L)			338					
(lbs/d)					333	340	102	85
Effluent TSS								
(mg/L)	30	45	116	121;84;106				
(lbs/d)	48	71				120		
(% removal)	85					66		
Fecal Coliform								
(#/100 mL)	200	400		80,000;110,000;51,000 BOF				
pH (s.u.)	6.0≤pH≤9.0			7.6;7.6				
Flow (MGD)	0.19				0.19	0.12	63	85

BOF - Bottle overfull.

Table 12. Comparison of Laboratory Results of Sample Splits, City of Mabton - Yakima River Basin Class II Inspections, 9/92

Location:	Inf-E		Inf-M		Eff-E		Eff-M	
Lab Log #:	388441		388442		388443		388444	
Date:	9/15-16		9/15-16		9/15-16		9/15-16	
Sampler:	Ecology		Mabton		Ecology		Mabton	
Laboratory:	Ecology	Mabton	Ecology	Mabton	Ecology	Mabton	Ecology	Mabton
BOD5 (mg/L)	108	---	86	---	38	---	31	---
TSS (mg/L)	338	---	242	---	116	---	78	---

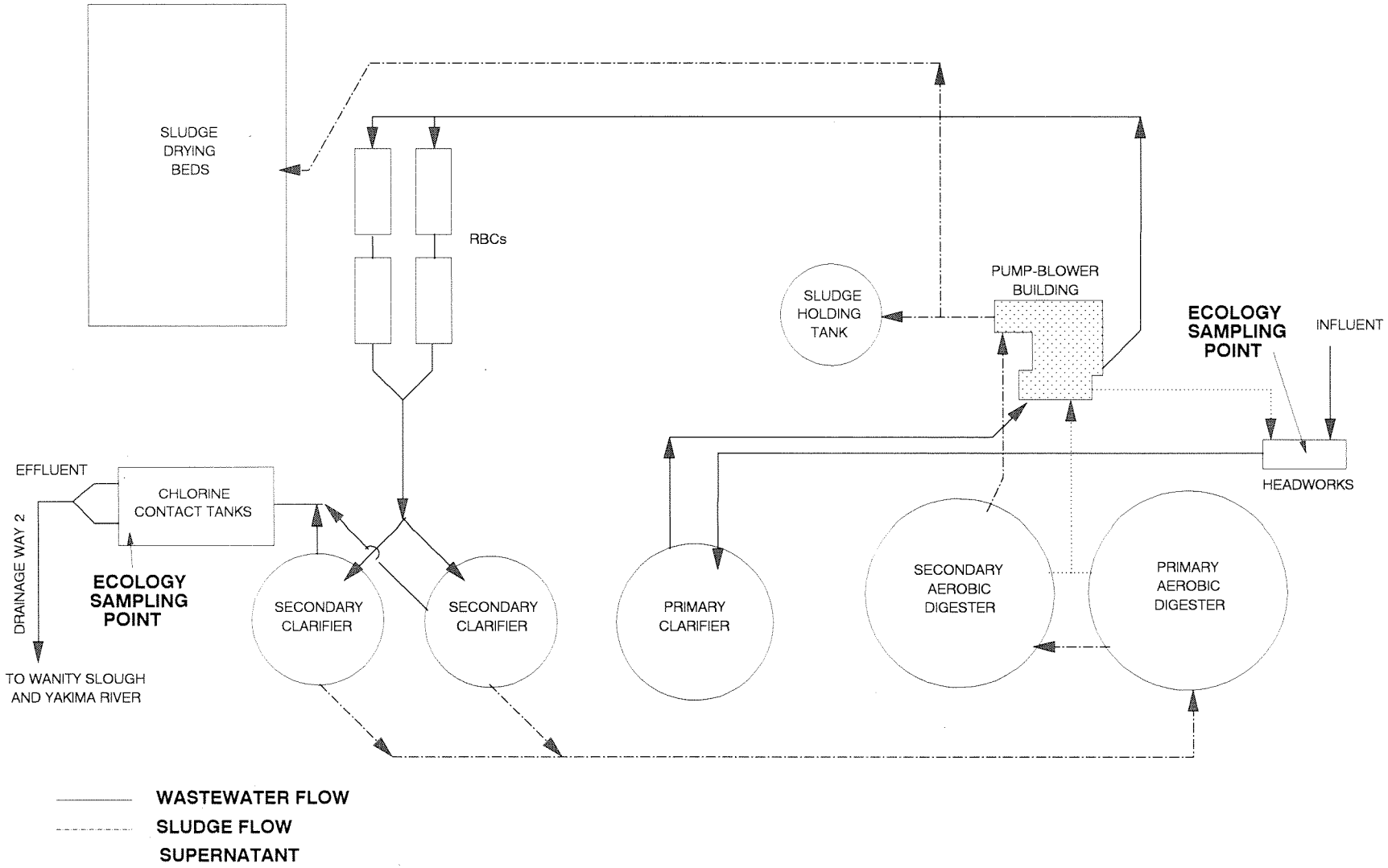

Figure 6. Plant Schematic - City of Wapato WWTP.

TSS and BOD_5 data in Table 13 support our observation that the RBCs were operating well. Biological growths were apparently at optimum thickness. However, the RBCs may be approaching their treatment capacity; air provided to the units has doubled since installation in 1979, but D.O. in effluent from the units has dropped from 6-7 to 2-4 mg/L (Freeborn, 1992).

Concentrations of ammonia in effluent (10.1 mg-N/L) exceeded both acute and chronic water quality criteria, which are about 7 and 1 mg-N/L, respectively. The amount of dilution within the mixing zone is not known at this time.

Fecal coliform and total coliform readings taken on the morning of the first day were exceptionally high. Apparently, adequate residuals of chlorine were not being maintained. There is no reason to view them as outliers. Statistical analysis of the BOD_{35} results yielded a UCBOD of 19.7 mg/L and a k constant of 0.10.

Maintenance and general appearance of the plant site needs to be improved. Rooted plants were growing on the center structures of the final clarifiers and on the baffles of the chlorine contact chambers. Duckweed covers the last one-sixth of the flow path in the chlorine contact chambers.

Table 14 compares inspection results to permit limits. The only noteworthy data are the one high fecal coliform reading and the TSS loading to the plant, which exceeded the design criterion. The permit stipulates that when loading exceeds 85 percent of the criterion, planning for continuing to maintain treatment capacity must begin.

Results from sample splits (Table 15) and standards are cause for some concern. Wapato's BOD_5 data are consistently higher than Ecology's data (from 70-160% higher). The result from their analysis of the BOD standard left with them in September was 40 percent higher than the true value, although still within the acceptance range. The analytical procedure should be reexamined. The TSS data suggest that Ecology's lab may have generated an outlier on Wapato's influent sample. Temperatures of all composited samples were well above the recommended 4°C. (APHA, 1989). Wapato's refrigeration units need to be checked.

Results from analyses of standards left with Wapato are as follows:

Parameter	WP Result	True Value	Acceptable Range
BOD_5	26.0 mg/L	18.6 mg/L	13.1 - 30.9 mg/L
Residual Cl_2	0.90 mg/L	1.40 mg/L	0.91 - 1.72 mg/L

Moxee

Moxee's plant consists of a bar screen, oxidation ditch, secondary clarifier, Parshall flume, and chlorine contact chamber (Figure 7). Discharge is through Moxee Ditch to the Yakima River. Sludge goes to drying beds. NPDES Permit No. WA-002250-1 was issued on June 29, 1988 and expires on June 29, 1993.

Table 13. General Chemistry Results, City of Wapato - Yakima River Basin Class II Inspections, 9/92.

Location:	Blank	Inf-E	Inf-W	Eff-E	Eff-W	Eff-1	Eff-2	Eff-T
Type:	Equip	Comp	Comp	Comp*	Comp	Grab	Grab	Grab
Date:	9/15	9/15-16	9/15-16	9/15-16	9/15-16	9/15	9/15	9/15
Time:	1930	24 hour	24 hour	24 hour	24 hour	0800	1525	1535
Lab Log #:	388450	388451	388452	388453	388454	388455	388456	388457
GENERAL CHEMISTRY								
Alkalinity (mg/L)		149		*		150	128	128
Conductivity (µmho/cm)		457		*				
Chloride (mg/L)					42.6			
TS (mg/L)		459	523	345	345	430	304	326
TNVS (mg/L)		259	265	239	248	267	196	199
TSS (mg/L)		125	238	11	11	17	11	10
TNVSS (mg/L)		1 U	77	1 U	1 U	5	3	1
BOD5 (mg/L)		84	74	6	6	7	6	6
BOD35 (mg/L)					69			
TOC (mg/L)				33.0				
NH3-N (mg/L)		12.7		10.1		11.0	11.5	11.5
NO2+NO3-N (mg/L)		0.09		2.40 H		0.76	2.62	2.62
T-Phosphate (mg/L)		3.51		3.03		3.60	3.29	2.57
O-Phosphate, dissolved (mg/L)	0.03			2.56		3.32	2.70	3.44
Kjeldahl Nitrogen (mg/L)		^		15.5		18.3	15.5	16.0
F-Coliform MF (#/100mL)						290,000	79 J	50 J
Total Coliform (#/100mL)						>320,000		
FIELD OBSERVATIONS								
Flow (MGD)				0.85				
Temperature (°C)		6.5**	11.3**	8.1**	12.5**	24.2	20.7	
pH (s.u.)		7.8	7.6	7.9	7.5	7.9	7.7	
Conductivity (µmho/cm)		475	480	480	480	430	410	
Chlorine, Free (mg/L)						0.1	0.6	
Total (mg/L)						0.1	1.0	

Inf - Influent; Eff - Effluent; E - Ecology sampler; W - Wapato sampler; T - Duplicate.

^ - Lab equipment malfunction.

* - Eleven hour composite; insufficient sample collected.

** - Iced composite.

J - Positively identified but result is estimated.

U - Not detected at or above the reported results.

H - Over recommended holding time.

Table 14. Comparison of Inspection Results to NPDES Permit Limits, City of Wapato – Yakima River Basin Class II Inspections, 9/92

	NPDES Permit Limits		Inspection Data		Loading and Performance			
Parameter	Monthly Average	Weekly Average	Ecology Composite	Grab Samples	Design Criteria (DC)	Derived Results	Plant Loading (% of DC)	Planning to begin (% of DC)
Influent BOD5								
(mg/L)			84					
(lbs/d)					1,030	600	68	85
Effluent BOD5								
(mg/L)	30	45	6	7;6;6				
(lbs/d)	155	232				43		
(% removal)	85					93		
Influent TSS								
(mg/L)			125					
(lbs/d)					790	890	112	85
Effluent TSS								
(mg/L)	30	45	11	17;11;10				
(lbs/d)	119	178				78		
(% removal)	85					91		
Fecal Coliform								
(#/100 mL)	400	400		290,000;79 J;50 J				
pH (s.u.)	6.0≤pH≤9.0			7.9;7.7				
Flow (MGD)	1.1				1.1	0.85	77	85

J – Positively identified but result is estimated.

Table 15. Comparison of Laboratory Results of Sample Splits, City of Wapato – Yakima River Basin Class II Inspections, 9/92

Location:	Inf-E		Inf-W		Eff-E		Eff-W	
Lab Log #:	388451		388452		388453		388454	
Date:	9/15-16		9/15-16		9/15-16		9/15-16	
Sampler:	Ecology		Wapato		Ecology		Wapato	
Laboratory:	Ecology	Wapato	Ecology	Wapato	Ecology	Wapato	Ecology	Wapato
BOD5 (mg/L)	84	217	74	163	6	10	6	11
TSS (mg/L)	125	101	238	105	11	10	11	12

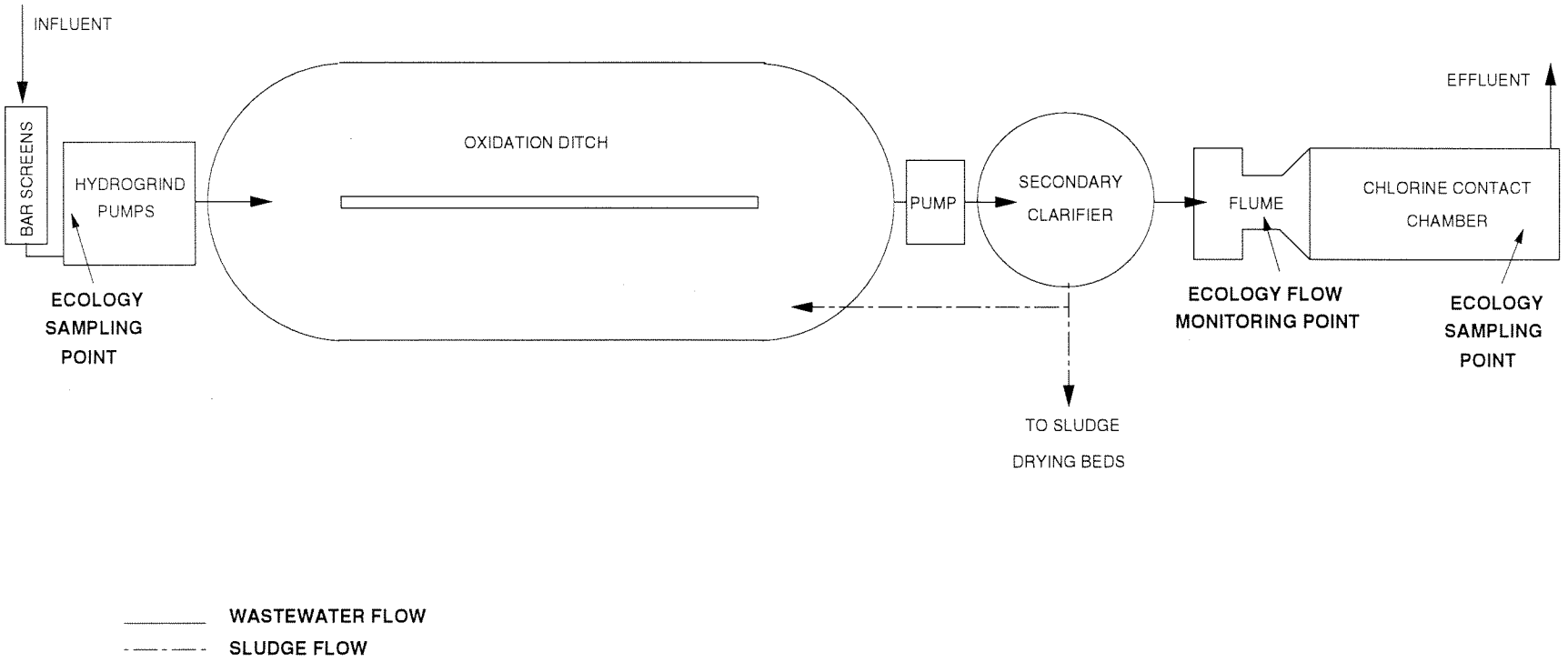

Figure 7. Plant Schematic - City of Moxee WWTP.

A three-inch Parshall flume is located immediately upstream of the chlorine contact chamber. Physical measurements and installation appeared to be correct. Instantaneous flow measurement produced a calculated flow of 0.46 MGD (ISCO, 1985) compared to a plant flow recorder reading of 0.38 MGD. Calibration of the instrumentation appears to be necessary. Totalizer readings on consecutive days (9/22-23) gave a 24-hour flow of 0.09 MGD.

This is an elementary, extended aeration activated sludge process, as the schematic in Figure 7 shows. However, it appeared to be difficult to operate due to the necessity of pumping wastewater both on the upstream and downstream side of the aeration basin. The basin acts somewhat like a batch reactor. Results in Table 16 show that nitrification was working exceptionally well, but BOD reduction and fecal coliform kills appeared to be erratic. BOD_{35}, UCBOD and k constant values were not considered accurate and have not been included.

The only potential permit violation was the high fecal coliform counts on day two of the inspection (geometric mean of 247). An influent BOD_5 concentration of >700 mg/L is shown in Table 17. If substantiated by later data received by the Regional Office on a Discharge Monitoring Report, this number would result in a loading which far exceeds the design criterion.

Table 18 shows sample split results for only TSS; the Moxee lab did not produce BOD results. There is nothing noteworthy in the data. Results from analyses of standards are as follows:

Parameter	MX Result	True Value	Acceptable Range
BOD_5	24.0 mg/L	18.6 mg/L	13.1 - 30.9 mg/L
Residual Cl_2	1.30 mg/L	1.40 mg/L	0.91 - 1.72 mg/L

Selah

Influent to the Selah WWTP passes through a comminutor and is pumped to aeration basins - operated as a complete mix extended aeration process (Figure 8). There are two clarifiers which are usually operated in parallel followed by two chlorine contact chambers. Discharge is to the Yakima River via Selah Ditch. Sludge is thickened and aerobically digested, to be dried or moved to a holding tank for later transport to the Yakima County sludge site near the Terrace Heights landfill. Discharge is regulated under NPDES permit no. WA-002103-2 with an issuance date of October 18, 1982. The permit expired on October 18, 1982 and has been administratively extended since then.

Flow is measured by an electronic meter located at the headworks. No verification of instantaneous flow readings could be done because there was no weir or flume in close proximity. The flow obtained from two readings of the totalizer spaced 24 hours apart was 0.964 MGD.

Table 16. General Chemistry Results, City of Moxee - Yakima River Basin Class II Inspections, 9/92.

Location:	Blank	Inf-E	Inf-M	Eff-E	Eff-M	Eff-1	Eff-2	Eff-T
Type:	Equip	Comp	Gr-Comp	Comp	Gr-Comp	Grab	Grab	Grab
Date:	9/22	9/22-23	9/22-23	9/22-23	9/22-23	9/22	9/22	9/22
Time:	1745	24 hour	8 hour	24 hour	8 hour	1035	1500	1505
Lab Log #:	398460	398461	398462	398463	398464	398465	398466	398467
GENERAL CHEMISTRY								
Alkalinity (mg/L)		270		166		146	149	148
Conductivity (μmho/cm)		953		586				
Chloride (mg/L)				52.4	41.3			
TS (mg/L)		941	816	456	678	371	416	388
TNVS (mg/L)		441	470	304	331	269	276	278
TSS (mg/L)		212	140	4	7	6	7	7
TNVSS (mg/L)		65	30	1 U	2	2	3	2
BOD5 (mg/L)		>700	>700	*	27	2	39	>42
TOC (mg/L)				86.2				
NH3-N (mg/L)		25.0		0.76		0.06	0.26	0.27
NO2+NO3-N (mg/L)		0.06		4.72		8.71	8.29	8.27
T-Phosphate (mg/L)		8.54 J		5.55 J		4.29 J	4.49 J	4.91 J
O-Phosphate, dissolved (mg/L)	0.01			3.86		3.77	4.57	4.35
Kjeldahl Nitrogen (mg/L)		36.7		1.8		1 U	1 U	1 U
F-Coliform MF (#/100mL)						7	1,800	1,200
FIELD OBSERVATIONS								
Flow (MGD)				0.09				
Temperature (°C)		6.5**	6.0**	6.7**	6.8**	20.4	30.9	
pH (s.u.)		7.5	7.4	7.4	7.5	7.4	7.5	
Conductivity (μmho/cm)		730	870	310	410	510	490	
Chlorine, Free (mg/L)						0.15	0.10	
Total (mg/L)						0.25	0.18	

Inf - Influent; Eff - Effluent; E - Ecology sampler; M - Moxee sampler; T - Duplicate.

* - Refer to Procedures and Data Quality Assurance section in text.

** - Iced composite.

J - Positively identified but result is estimated.

U - Not detected at or above the reported result.

Table 17. Comparison of Inspection Results to NPDES Permit Limits, City of Moxee - Yakima River Basin Class II Inspections, 9/92

	NPDES Permit Limits		Inspection Data		Loading and Performance			
Parameter	Monthly Average	Weekly Average	Ecology Composite	Grab Samples	Design Criteria (DC)	Derived Results	Plant Loading (% of DC)	Planning to begin (% of DC)
Influent BOD5								
(mg/L)			700					
(lbs/d)					255	520	206	85
Effluent BOD5								
(mg/L)	30	45		2;39;>42				
(lbs/d)	38	56				21		
(% removal)	85							
Influent TSS								
(mg/L)			212					
(lbs/d)					255	160	63	85
Effluent TSS								
(mg/L)	30	45	4	6;7;7				
(lbs/d)	38	56				3		
(% removal)	85					98		
Fecal Coliform								
(#/100 mL)	200	400		7;1,800;1,200				
pH (s.u.)	6.0 pH 9.0			7.4;7.5				
Flow (MGD)	0.15				0.15	0.09	60	85

Table 18. Comparison of Laboratory Results of Sample Splits, City of Moxee - Yakima River Basin Class II Inspections, 9/92

Location:	Inf-E		Inf-M		Eff-E		Eff-M	
Lab Log #:	398461		398462		398463		398464	
Date:	9/22-23		9/22-23		9/22-23		9/22-23	
Sampler:	Ecology		Moxee		Ecology		Moxee	
Laboratory:	Ecology	Moxee	Ecology	Moxee	Ecology	Moxee	Ecology	Moxee
TSS (mg/L)	212	136	140	144	4	9	7	8

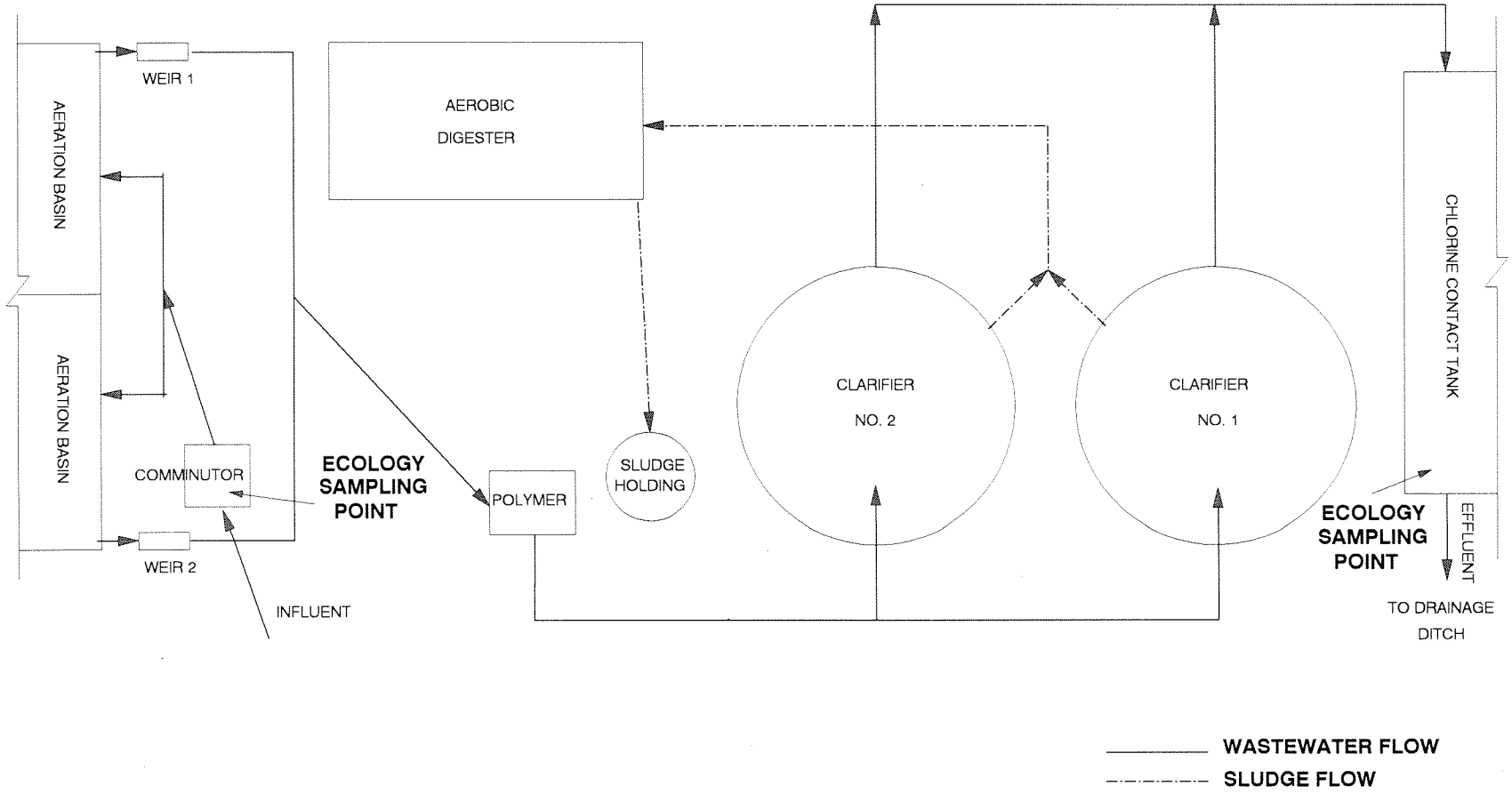

Figure 8. Plant Schematic - City of Selah WWTP.

The results in Table 19 reflect a WWTP which was operating very well. Nitrification was nearly complete, reducing the ammonia concentration to <0.1 mg/L. Nothing else among the data appears noteworthy. While it was reported that diatomaceous earth from Hi-Country had been a problem, there were no signs of that problem during the inspection. The plant site was well maintained. The lab was immaculate and well organized. The statistically determined UCBOD and k constant were 11.2 mg/L and 0.012, respectively.

Table 20 shows that all permit limits were being met. Table 21 shows that the results of influent sample splits analyzed by Ecology were substantially lower than those same samples analyzed by Selah. Analysis of standards might have shed some light on this disparity. However, no standards were left because Selah's lab has been accredited by Ecology.

Ellensburg

The Ellensburg WWTP (Figure 9), with a hydraulic design capacity of eight million gallons per day (MGD), is classified as an NPDES "major" permittee. Influent is pumped to the grit removal basin and flows by gravity to one of the two aeration basins, which are operated in parallel. After a detention time of approximately 12 hours, wastewater moves to one of two secondary clarifiers. Chlorine is introduced to the effluent either as it passes over the sawtooth weirs at the clarifiers (summertime) or as it flows to the chlorine contact chamber. Flow is measured with a propeller meter at the head of the chamber. Discharge is to the Yakima River. Waste sludge is centrifuged, pumped to primary and secondary anaerobic digesters (operated in series), and then to drying beds. NPDES Permit No. WA-002434-1 was issued on June 18, 1990. It has an expiration date of July 1, 1995.

The flow measurement device is an in-line propeller type. Verification of instantaneous flow was not possible. Two totalizer readings (from 0800 on September 22 until 0800 on September 23) gave 3.62 MGD.

The WWTP was operating well, which is reflected in the data found in Table 22. The amount of ammonia in the wastewater was not reduced appreciably during treatment, and the effluent concentration (9.4 mg/L) is potentially cause for concern. The chronic criterion is about 2 mg-N/L, but 5:1 dilution (assuming low background concentrations) in a mixing zone should alleviate toxicity. Fecal coliform counts were elevated in two of three grab samples. The plant site appeared to be very well maintained. BOD_{35} data and UCBOD/k constant statistical results were not considered accurate and are not included.

The potential existed for violating both weekly and monthly average permit limits for fecal coliform if counts continued at levels found during the inspection (geometric mean of 382). Insufficient contact time is a possible explanation; a dye test would confirm this. All other results in Table 23 show a WWTP operating efficiently and well within design criteria.

Table 19. General Chemistry Results, City of Selah – Yakima River Basin Class II Inspections, 9/92.

Location:	Blank	Inf-E	Inf-S	Eff-E	Eff-S	Eff-1	Eff-2	Eff-T
Type:	Equip	Comp	Comp	Comp	Comp	Grab	Grab	Grab
Date:	9/22	9/22-23	9/22-23	9/22-23	9/22-23	9/22	9/22	9/22
Time:	1745	24 hour	24 hour	24 hour	24 hour	0945	1410	1415
Lab Log #:	398470	398471	398472	398473	398474	398475	398476	398477
GENERAL CHEMISTRY								
Alkalinity (mg/L)		254		214		212	210	211
Conductivity (μmho/cm)		925		753				
Chloride (mg/L)				78.2	77.8			
TS (mg/L)		1230	874	509	535	516	511	533
TNVS (mg/L)		580	474	420	384	395	398	395
TSS (mg/L)		339	148	4	3	5	6	5
TNVSS (mg/L)		109	29	2	1 U	2	2	1
BOD5 (mg/L)		430	345	3 U	3 U	3	2	2
BOD35 (mg/L)				6				
TOC (mg/L)				54.3				
NH3-N (mg/L)		12.7		0.04		0.04	0.04	0.04
NO2+NO3-N (mg/L)		0.76		2.23		2.77	2.73	2.75
T-Phosphate (mg/L)		5.79 J		2.85 J		2.76 J	2.89 J	2.71 J
O-Phosphate, dissolved (mg/L)	0.04			2.18		2.51	2.37	2.07
Kjeldahl Nitrogen (mg/L)		22.3		1 U		7.8	5.7	1 U
F-Coliform MF (#/100mL)						7 U	7	7 U
FIELD OBSERVATIONS								
Flow (MGD)				0.96				
Temperature (°C)		8.5*	9.7*	10.0*	10.0*	15.6	32.1	
pH (s.u.)		7.7	7.1	8.0	7.8	7.5	7.6	
Conductivity (μmho/cm)		870	850	600	560	950	650	
Chlorine, Free (mg/L)						0.4	0.1	
Total (mg/L)						1.0	0.5	

Inf - Influent; Eff - Effluent; E - Ecology sampler; S - Selah sampler; T - Duplicate

J - Positively identified but result is estimated.

U - Not detected at or above the reported result.

* - Iced composite.

Table 20. Comparison of Inspection Results to NPDES Permit Limits, City of Selah – Yakima River Basin Class II Inspections, 9/92

	NPDES Permit Limits		Inspection Data		Loading and Performance			
Parameter	Monthly Average	Weekly Average	Ecology Composite	Grab Samples	Design Criteria (DC)	Derived Results	Plant Loading (% of DC)	Planning to begin (% of DC)
Influent BOD5								
(mg/L)			430					
(lbs/d)					6,000	3,400	57	85
Effluent BOD5								
(mg/L)	30	45	3 U	3;2;2				
(lbs/d)	525	788				20		
(% removal)	85					>99		
Influent TSS								
(mg/L)			339					
(lbs/d)					6,130	2,700	44	85
Effluent TSS								
(mg/L)	30	45	4	5;6;5				
(lbs/d)	525	788				32		
(% removal)	85					99		
Fecal Coliform								
(#/100 mL)	200	400		7 U;7;7 U				
Ammonia Nitrogen								
(mg/L)	≤15 from 5/1 to 10/30		0.04	0.04				
pH (s.u.)	6.0≤pH≤9.0			7.5;7.6				
Flow (MGD)	2.1				2.1 (4.6*)	0.96	46	85

U – Not detected at or above the reported result.

* – Peak monthly average flow.

Table 21. Comparison of Laboratory Results of Sample Splits, City of Selah – Yakima River Basin Class II Inspections, 9/92

Location:	Inf-E		Inf-S		Eff-E		Eff-S	
Lab Log #:	398471		398472		398473		398474	
Date:	9/22-23		9/22-23		9/22-23		9/22-23	
Sampler:	Ecology		Selah		Ecology		Selah	
Laboratory:	Ecology	Selah	Ecology	Selah	Ecology	Selah	Ecology	Selah
BOD5 (mg/L)	430	633	345	390	3 U	4.9	3 U	4.5
TSS (mg/L)	339	575	148	185	4	5	3	5

U – Not detected at or above the reported result.

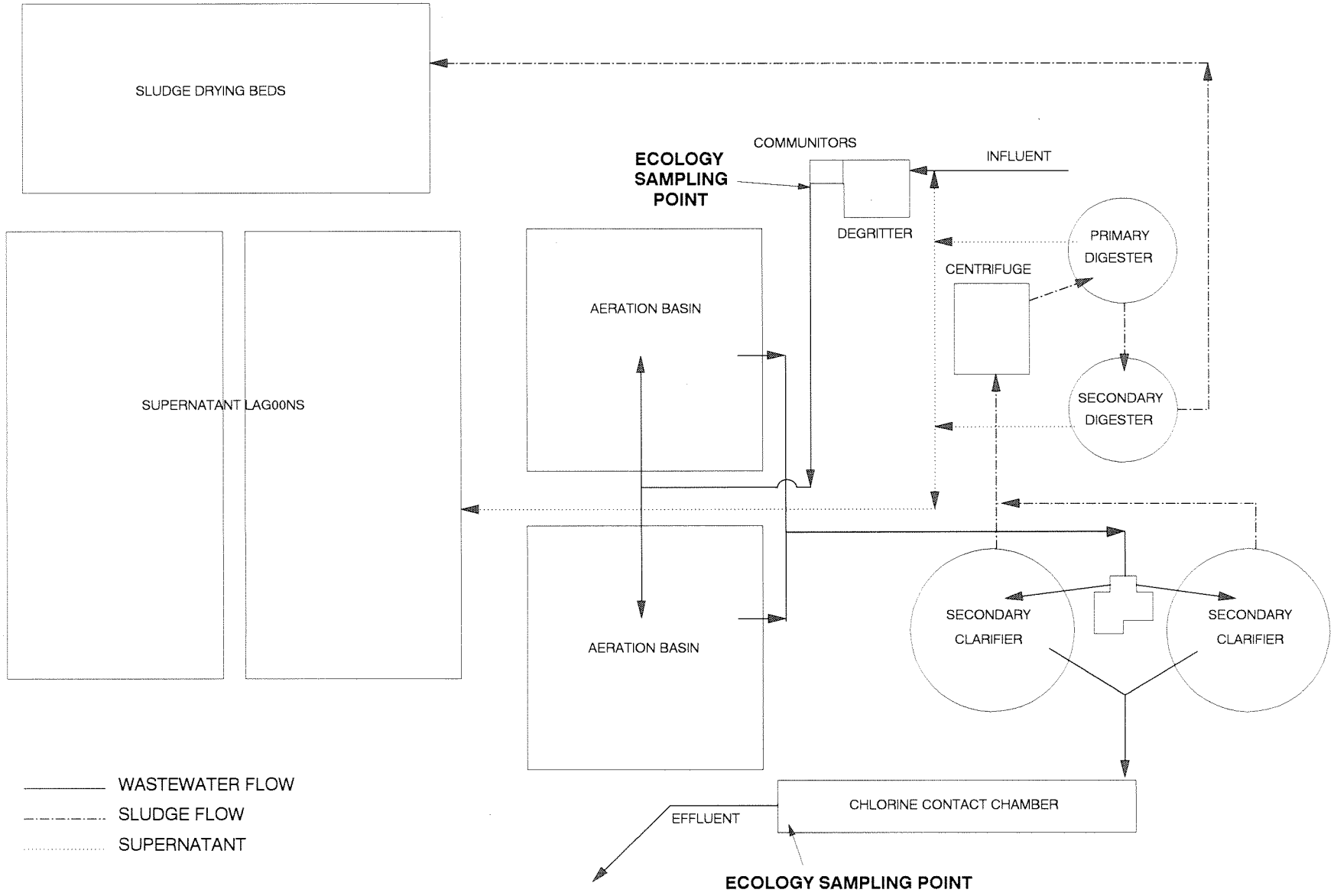

Figure 9. Plant Schematic - City of Ellensburg WWTP.

Table 22. General Chemistry Results, City of Ellensburg - Yakima River Basin Class II Inspections, 9/92.

Location:	Blank	Inf-E	Inf-L	Eff-E	Eff-L	Eff-1	Eff-2	Eff-T
Type:	Equip	Comp	Comp	Comp	Comp	Grab	Grab	Grab
Date:	9/22	9/22-23	9/22-23	9/22-23	9/22-23	9/22	9/23	9/22
Time:	1745	24 hour	24 hour	24 hour	24 hour	0800	1440	1445
Lab Log #:	398480	398481	398482	398483	398484	398485	398486	398487
GENERAL CHEMISTRY								
Alkalinity (mg/L)		156		157		154	150	156
Conductivity (μmho/cm)		507		570				
Chloride (mg/L)				66.0	65.7			
TS (mg/L)		511	457	344	358	308	327	346
TNVS (mg/L)		287	258	232	226	250	235	201
TSS (mg/L)		195	138	6	8	6	5	3
TNVSS (mg/L)		57	24	2	3	1 U	2	1
BOD5 (mg/L)		74	100	5	9	5	4	8
TOC (mg/L)				42.9				
NH3-N (mg/L)		10.2		9.41		9.67	8.31	9.54
NO2+NO3-N (mg/L)		0.23		0.01 U		0.01 U	0.015	0.01 U
T-Phosphate (mg/L)		2.51 J		2.21 J		3.08 J	0.56 J	2.69 J
O-Phosphate, dissolved (mg/L)	0.01 U			1.64		2.33	0.68	2.67
Kjeldahl Nitrogen (mg/L)		*		*		10.6	*	*
F-Coliform MF (#/100mL)						800	120	590
FIELD OBSERVATIONS								
Flow (MGD)				3.62				
Temperature (°C)		10.8**	12.9**	11.5**	12.4**	12.3	18.1	
pH (s.u.)		7.6	7.5	7.7	7.8	7.3	7.0	
Conductivity (μmho/cm)		485	600	520	650	540	630	
Chlorine, Free (mg/L)						0.10	0.25	
Total (mg/L)						0.15	0.60	

Inf - Influent; Eff - Effluent; E - Ecology sampler; L - Ellensburg sampler; T - Duplicate.

* - Refer to Procedures and Data Quality Assurance section in text.

** - Iced composite.

U - Not detected at or above the reported result.

J - Positively identified but result is estimated.

Table 23. Comparison of Inspection Results to NPDES Permit Limits, City of Ellensburg – Yakima River Basin Class II Inspections, 9/92

	NPDES Permit Limits		Inspection Data		Loading and Performance			
Parameter	Monthly Average	Weekly Average	Ecology Composite	Grab Samples	Design Criteria (DC)	Derived Results	Plant Loading (% of DC)	Planning to begin (% of DC)
Influent BOD5								
(mg/L)			74					
(lbs/d)					10,000	2,200	22	85
Effluent BOD5								
(mg/L)	30	45	5	5;4;8				
(lbs/d)	1,500	2,250				150		
(% removal)	85					93		
Influent TSS								
(mg/L)			195					
(lbs/d)					8,000	5,900	74	85
Effluent TSS								
(mg/L)	30	45	6	6;5;3				
(lbs/d)	1,200	1,800				180		
(% removal)	85					97		
Fecal Coliform								
(#/100 mL)	200	400		800;120;590				
pH (s.u.)	6.0≤pH≤9.0			7.3;7.0				
Flow (MGD)	8.0				8.0	3.62	45	85

BOD_5 data in Table 24 followed a pattern established throughout this survey (*i.e.*, influent results from Ecology's contract lab were substantially lower than results from the permittee lab). As mentioned earlier, this may be due in part to the types of seeds used.

Granger

Granger recently completed an upgrade to their WWTP (Figure 10). Flow passes through a Parshall flume to an oxidation ditch, and from there to a pair of final clarifiers which are operated in series (but can be operated in parallel). Effluent passes through the chlorine contact chamber and is discharged to the Granger Drain and on to the Yakima River. Wasted sludge is further treated in an aerated holding tank and drying beds. Discharge from the Granger WWTP is regulated under NPDES permit no. WA-002269-1 which was issued on March 31, 1989. The permit expires on March 31, 1994.

A Parshall flume with ultrasonic level detector is part of the headworks. Physical dimensions were correct. The instantaneous flow was calculated to be 0.29 MGD by physically measuring water level in the flume and reading from a table (ISCO, 1985). The digital readout in the control room was 0.24 MGD. Recalibration of the instrumentation would be advisable. Twenty-four flow from the totalizer was 0.16 MGD.

Data in Table 25 indicate that the WWTP was operating well. Nitrification was producing a dramatic reduction in ammonia. Free chlorine was elevated (0.55 mg/L @ noon). The plant site looked clean and well maintained; it is in a one-year certification review after completion of a plant upgrade. The UCBOD and k constant results from statistical curve fitting to the BOD_{35} data are 21.8 mg/L and 0.017, respectively.

Permit limits were being met. The only noteworthy result on Table 26 was the influent loading data for TSS. The maximum month average design criterion for the upgraded plant is 320 lb/day (Granger, 1991); the number for the old plant configuration (contained in the permit) is 460 lb/day. Loading during the inspection based on a 24-hour composite was 450 lb/day, which was 141 percent of the criterion.

Results contained in Table 27 suggest that Granger's 8-hour, grab-composite sampling procedure may not be producing representative samples. Influent TSS results from their sample (150 & 179 mg/L) are significantly lower than results from Ecology's 24-hour composite (339 & 421 mg/L). BOD_5 results follow a similar, though less pronounced, pattern. If historic grab-composite results were used in the design of the current upgrade, this may prove to be an unfortunate oversight. Automatic compositors should be used if disparities of this size are consistently found. Results from analyses of standards are as follows:

Parameter	GR Result	True Value	Acceptable Range
BOD	20.5 mg/L	18.6 mg/L	13.1 - 30.9 mg/L
Residual Cl_2	1.20 mg/L	1.40 mg/L	0.91 - 1.72 mg/L

Table 24. Comparison of Laboratory Results of Sample Splits, City of Ellensburg - Yakima River Basin Class II Inspections, 9/92

Station ID:	InfLN-E		InfLN-L		EffLN-E		EffLN-L	
Lab Number:	398481		398482		398483		398484	
Date:	9/22-23		9/22-23		9/22-23		9/22-23	
Sampler:	Ecology		Ellensburg		Ecology		Ellensburg	
Laboratory:	Ecology	Ellensburg	Ecology	Ellensburg	Ecology	Ellensburg	Ecology	Ellensburg
BOD5 (mg/L)	74	142	100	131	5	7	9	10
TSS (mg/L)	195	157	138	91	6	6	8	7

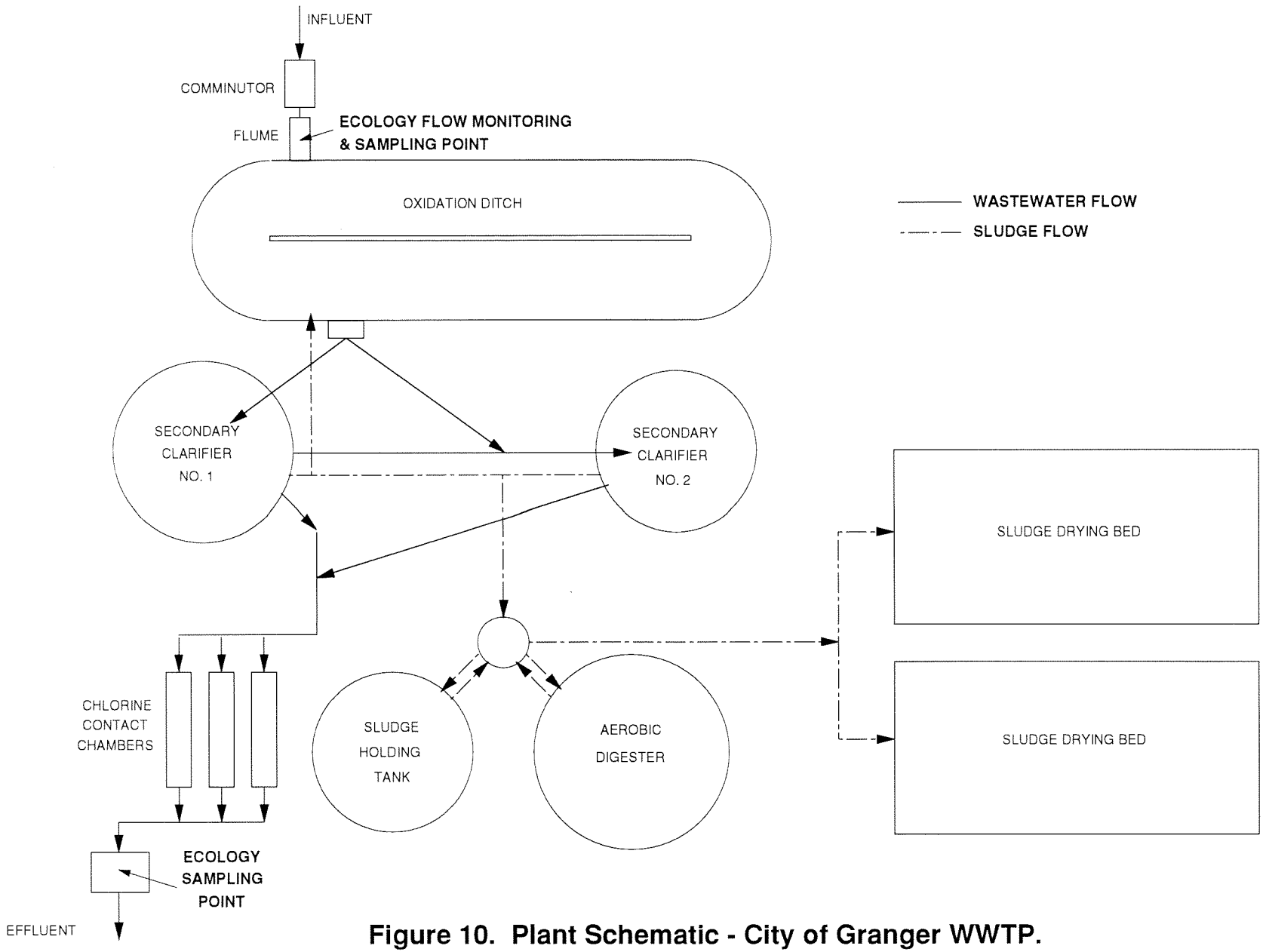

Figure 10. Plant Schematic - City of Granger WWTP.

Table 25. General Chemistry Results, City of Granger - Yakima River Basin Class II Inspections, 9/92.

Location:	Blank	Inf-E	Inf-G	Eff-E	Eff-G	Eff-1	Eff-2	Eff-T
Type:	Equip	Comp	Comp	Comp	Comp	Grab	Grab	Grab
Date:	9/22	9/22-23	9/22-23	9/22-23	9/22-23	9/22	9/22	9/22
Time:	1745	24 hour	24 hour	24 hour	24 hour	1145	1610	1615
Lab Log #:	398490	398491	398492	398493	398494	398495	398496	398497
GENERAL CHEMISTRY								
Alkalinity (mg/L)		312		201		203	199	198
Conductivity (µmho/cm)		792		607				
Chloride (mg/L)				46.1	46.0			
TS (mg/L)		816	693	424	430	425	401	553
TNVS (mg/L)		352	329	285	280	305	316	302
TSS (mg/L)		339	150	3	3	3	2	2
TNVSS (mg/L)		56	30	2	1	2	1	61
BOD5 (mg/L)		235	141	11	10	12	12	12
BOD35 (mg/L)				24				
TOC (mg/L)				51.8				
NH3-N (mg/L)		28.5		1.93		1.67	1.17	1.77
NO2+NO3-N (mg/L)		0.02		3.64		2.89	4.28	4.32
T-Phosphate (mg/L)		7.75 J		2.85 J		2.69 J	2.73 J	2.89 J
O-Phosphate, dissolved (mg/L)	0.03			2.15		2.96	2.19	2.74
Kjeldahl Nitrogen (mg/L)		47.5		3.1		2.5	2.9	1.5
F-Coliform MF (#/100mL)						7 U	7 U	7 U
FIELD OBSERVATIONS								
Flow (MGD)				0.16				
Temperature (°C)		7.5*	8.0*	7.0*	7.0*	25.5	32.2	
pH (s.u.)		8.0	7.5	7.5	7.7	7.6	7.5	
Conductivity (µmho/cm)		530	540	550	555	600	510	
Chlorine, Free (mg/L)						0.55	0.30	
Total (mg/L)						0.8	0.70	

Inf - Influent; Eff - Effluent; E - Ecology sampler; G - Granger sampler; T - Duplicate.

* - Iced composite;

J - Positively identified but result is estimated.

U - Not detected at or above the reported results.

Table 26. Comparison of Inspection Results to NPDES Permit Limits, City of Granger - Yakima River Basin Class II Inspections, 9/92

	NPDES Permit Limits		Inspection Data		Loading and Performance			
Parameter	Monthly Average	Weekly Average	Ecology Composite	Grab Samples	Design Criteria (DC)	Derived Results	Plant Loading (% of DC)	Planning to begin (% of DC)
Influent BOD5								
(mg/L)			235					
(lbs/d)					450*	310	69	85
Effluent BOD5								
(mg/L)	30	45	11	12;12;12				
(lbs/d)	58	86				15		
(% removal)	85					95		
Influent TSS								
(mg/L)			339					
(lbs/d)					320*	460	141	85
Effluent TSS								
(mg/L)	30	45	3	3;2;2				
(lbs/d)	58	86				4		
(% removal)	85					99		
Fecal Coliform								
(#/100 mL)	200	400		7 U;7 U;7 U				
pH (s.u.)	6.0≤pH≤9.0			7.6;7.5				
Flow (MGD)	0.23				0.27*	0.16	59	85

U - Not detected at or above the reported results.

* - Maximum monthly average for newly upgraded WWTP (Granger, 1991).

Table 27. Comparison of Laboratory Results of Sample Splits, City of Granger - Yakima River Basin Class II Inspections, 9/92

Location:	Inf-E		Inf-G		Eff-E		Eff-G	
Lab Log #:	398491		398492		398493		398494	
Date:	9/22-23		9/22-23		9/22-23		9/22-23	
Sampler:	Ecology		Granger		Ecology		Granger	
Laboratory:	Ecology	Granger	Ecology	Granger	Ecology	Granger	Ecology	Granger
BOD5 (mg/L)	235	282	141	190	11	6	10	14
TSS (mg/L)	339	421	150	179	3	2	3	0

CONCLUSIONS AND RECOMMENDATIONS

These nine inspections were conducted late in the summer because, generally speaking, groundwater levels are high and surface water levels are at their lowest during this time of the year in central Washington. This presents the opportunity for worst-case conditions in terms of violating permit limitations and degrading surface waters of the state. The inspections were unannounced; this increases the opportunity for documenting worst-case conditions. In total, the lab results and field observations indicated that a respectable job was being done of disposing of municipal wastewater. Inspection of sludge disposal was not part of the scope of work.

Specific problems found at each site have been discussed in detail above and will not be repeated here. The most frequent problems, each occurring at about half the plants, were:

- potential for chlorine toxicity in the receiving water;
- potential for ammonia toxicity/nutrient enrichment in the receiving water;
- wasteload to WWTP exceeds design criterion(a);
- potential for violation of weekly/monthly average fecal counts; and
- flow measuring instrumentation needs calibration.

It is difficult in hot weather to keep samples at 4°C (particularly those collecting in compositors). Elevated sample temperatures can yield erroneous monitoring data for BOD_5 and TSS. Several plant sites need better maintenance practices; several are understaffed. Two of the WWTPs have considerably more problems than the remaining seven, namely Zillah and Mabton.

Six of the nine facilities inspected during this survey have wastewater discharge permits that are due for reissuance. The potential of receiving water toxicity and plant overloading are two issues which should be addressed in revised permits, specifically by requiring mixing zone evaluations and planning for plant upgrades.

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APPENDICES

Appendix A. Chemical Analytical Methods and Laboratories – Yakima River Basin Class II Inspections, 9/92.

Parameter	Method	Lab used
Alkalinity	EPA, 1983: 310.1	Ecology; Manchester, WA
Conductivity	EPA, 1983: 120.1	Ecology; Manchester, WA
Chloride	EPA, 1983: 330.0	Ecology; Manchester, WA
Chlorophyll a	APHA, 1989:10200H(3)	Ecology; Manchester, WA
Pheophytin a	APHA, 1989:10200H(3)	Ecology; Manchester, WA
SOLIDS4		
TS	EPA, 1983: 160.3	Ecology; Manchester, WA
TNVS	EPA, 1983: 160.4	Ecology; Manchester, WA
TSS	EPA, 1983: 160.2	Ecology; Manchester, WA
TNVSS	EPA, 1983: 160.4	Ecology; Manchester, WA
BOD5	EPA, 1983: 405.1	Water Mgmt. Lab. Inc.; Tacoma, WA
BOD35	Whittemore, 1991	Ecology; Manchester, WA
TOC (water)	EPA, 1983: 415.2	Water Mgmt. Lab. Inc.; Tacoma, WA
NUTRIENTS		
NH3-N	EPA, 1983: 350.1	Ecology; Manchester, WA
NO2+NO3-N	EPA, 1983: 353.2	Ecology; Manchester, WA
NO2-N	EPA, 1983: 353.2	Ecology; Manchester, WA
NO3-N	EPA, 1983: 352.2	Ecology; Manchester, WA
T-phosphorus	EPA, 1983: 365.1	Ecology; Manchester, WA
O-phosphate	EPA, 1983: 365.3	Ecology; Manchester, WA
T-Kjeldahl nitrogen	EPA, 1983: 351.3	Water Mgmt. Lab. Inc.; Tacoma, WA
Fecal Coliform MF	APHA, 1989:9222D	Ecology; Manchester, WA
Total Coliform MF	APHA, 1989:9222B	Ecology; Manchester, WA

Appendix B. Typical Suite of General Chemistry Analyses Conducted – Yakima River Basin Class II Inspections, 9/92.

Location:	Blank	Inf-E	Inf-TP	Eff-E	Eff-TP	Eff-1	Eff-2	Eff-T
Type:	Equip	Comp	Comp	Comp	Comp	Grab	Grab	Grab
Date:								
Time:	1930	24 hour	24 hour	24 hour	24 hour	1045	1615	1625
Lab Log #:								
GENERAL CHEMISTRY								
Alkalinity (mg/L)		X		X	X	X	X	X
Conductivity (μmho/cm)		X		X				
Chloride (mg/L)		X		X				
TS (mg/L)		X	X	X	X	X	X	X
TNVS (mg/L)		X	X	X	X	X	X	X
TSS (mg/L)		X	X	X	X	X	X	X
TNVSS (mg/L)		X	X	X	X	X	X	X
BOD5 (mg/L)		X	X	X	X	X	X	X
BOD35 (mg/L)				X				
NH3-N (mg/L)		X		X		X	X	X
NO2+NO3-N (mg/L)		X		X		X	X	X
T-Phosphate (mg/L)		X		X		X	X	X
O-Phosphate, dissolved (mg/L)	X			X		X	X	X
Kjeldahl Nitrogen (mg/L)		X		X		X	X	X
F-Coliform MF (#/100mL)						X	X	X
FIELD OBSERVATIONS								
Flow (MGD)				X				
Temperature (°C)		X		X		X	X	
pH (s.u.)		X		X		X	X	
Conductivity (μmho/cm)		X		X		X	X	
Chlorine, Free (mg/L)						X	X	
Total (mg/L)						X	X	

Inf - Influent; Eff - Effluent; E - Ecology sampler; TP - Treatment Plant sampler; T - duplicate